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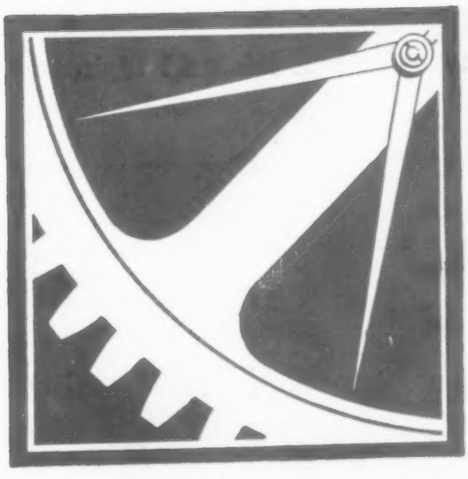

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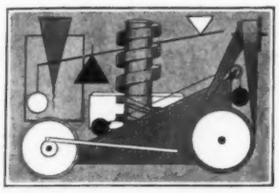

In This ISSUE

SPECIAL attention is drawn to the leading article commencing on page 19 of this number, and to the announcement which accompanies the contribution. In this it will be seen that MACHINE DESIGN *plans to publish other articles along similar lines, but dealing with trends in design of machinery used in industries other than woodworking.*

It is believed that a series of articles of this nature, dealing with the most up-to-date developments in machine design, which are taking place in such fields as the machine tool, textile, agricultural, dairy, ceramic and many others, will serve an exceeding useful purpose in disseminating information among our readers.

L. E. Jermy.
Managing Editor

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Itemized Index, November, 1930

Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

Compiled for the assistance of engineers confronted with specific design problems

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THROUGH the steady advance of civilization, man constantly is gaining new knowledge with which to improve his position. In industry his facilities for creating and developing new means of performing work are expanding rapidly. Almost daily new methods and new materials are made available for his use.

In this machine age, it is becoming increasingly necessary that those who are responsible for designing mechanical equipment be informed of the progress in machine design in all industries. More and more it is important that the ideas developed for one type of machinery be carefully scrutinized for possible application to other types. Today, to a greater extent than ever before, design is universal.

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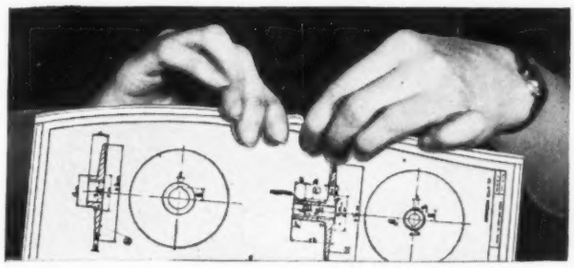

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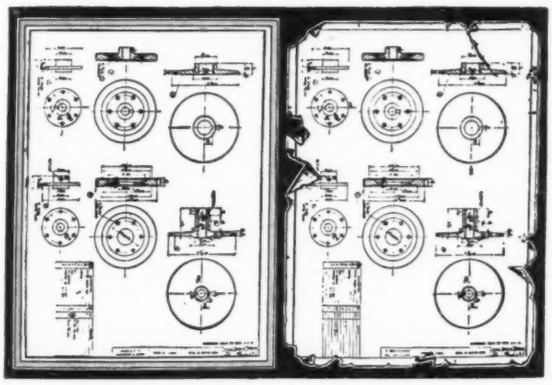

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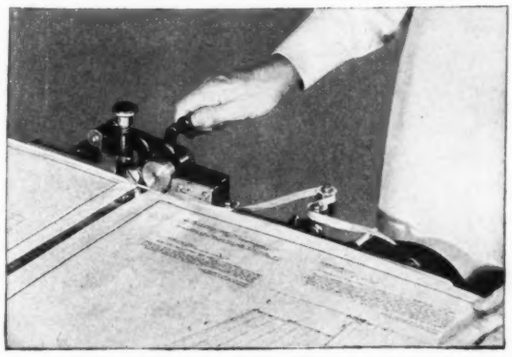

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CALENDAR OF MEETINGS AND EXPOSITIONS

Dec. 1-5—American Society of Mechanical Engineers. Fifty-first annual meeting to be held at the Engineering Societies building, New York. Papers to be presented on the technical program will cover applied mechanics, lubrication engineering, hydraulics, materials, machine shop practice, and industrial power. Some of the subjects pertinent to design include "Design of the Miller Simplex Automatic Two-Revolution Cylinder Press," "Transmission of Torque by Means of Press and Shrink Fits," "Properties of Nonferrous Alloys at Elevated Temperatures," "Some Problems in Standardization," "Design of the New Harris Automatic Two-Color Flat-Bed Press," "Problems in the Theory of Fluid-Film Lubrication with an Experimental Method of Solution," "Special Applications of Electric Motors in Cloth Finishing Plants," "Plastic Torsion," "Elastic and Inelastic Behavior in Spring Materials," "Sizes and Tolerances for Metals Fits," and "Design of Conical Spring with Coils of a Uniform Slope." Lectures on public speaking by S. M. Tucker, noted lecturer and teacher of English, will be one of the features. Another highlight will be an exhibition of art produced by engineers. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary of the society.

Dec. 1-6—National Power Show. Ninth national exposition of power and mechanical engineering to be held in Grand Central Palace, New York. Exhibits will show the latest developments in the most effective and economical methods of producing, increasing and applying power to present-day requirements. During the same week the annual meetings of the American Society of Mechanical Engineering and American Society of Refrigerating engineers will be held at the Engineering Societies building and Hotel New Yorker, respectively. Management of the power show is under the direction of Charles F. Roth and Fred W. Paine, with offices in Grand Central Palace, Lexington avenue, New York.

Dec. 3-6—American Society of Refrigerating Engineers. Annual meeting at Hotel New Yorker, New York, during week of ninth national exposition of power and mechanical engineering. David L. Fiske, 37 West Thirty-ninth street, New York, is secretary.

Dec. 10-25—International Aerial Safety congress. First international congress for discussion of safety in the air and means to hasten its progress is to be held in Paris. At a conference held by the department of commerce in Washington last spring it was decided to endeavor to secure ten papers by American authorities for presentation at the congress. French will be the official language, but authors may submit papers in other languages to the technical examining committee. English, German, Italian and Spanish interpreters will be available for discussions.

Dec. 11—American Standards association. Annual meeting at Engineering Societies building, New York. P. G. Agnew, 29 West Thirty-ninth street, New York, is secretary of the organization.

Jan. 10-16, 1931—American Road Builders association. Twenty-eighth annual convention and road show to be held in St. Louis. The opening day has been set aside for distributors and manufacturers, thereby leaving Jan. 12 as the date of the official opening.

Jan. 19-23—Society of Automotive Engineers. Annual meeting to be held in Detroit. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary of the society.

Jan. 26-30, 1931—American Institute of Electrical Engineers. Annual winter convention to be held in New York. F. L. Hutchinson, 33 West Thirty-ninth street, New York, is secretary of the organization.

Feb. 10-14, 1931—Midwestern Power Show. Fifth midwestern power engineering conference and exposition, generally known as the Chicago power show, to be held in Chicago. G. E. Pfisterer, 53 West Jackson boulevard, Chicago, is secretary.

Feb. 16-20, 1931—Western Metal congress. Second National Western Metal congress and exposition to be held in Civic auditorium, San Francisco, under the auspices of the American Society for Steel Treating. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is secretary.

April 12-16, 1931—American Society of Mechanical Engineers. Joint national meeting of the materials handling and management division to be held in Cleveland at the time of the industrial equipment exposition. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary of the society.

May 4-8, 1931 — American Foundrymen's association. 1931 annual convention and exhibition to be held at Stevens hotel, Chicago. C. E. Hoyt, 222 West Adams street, Chicago, is secretary of the organization.

May 7-9, 1931—American Gear Mfgrs' Association. Annual spring meeting to be held at Hotel Statler, Buffalo. T. W. Owen, 3608 Euclid avenue, Cleveland, is secretary of the organization.

MACHINE DESIGN
November 1930

Trends in Design—Woodworking Machinery

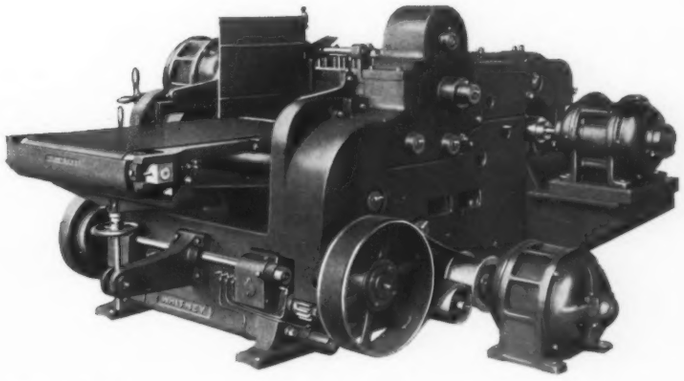


Fig. 2—Cabinet planer of modern design

By George F. Cosgrove

TO PORTRAY trends in design of machinery used in various industries, Machine Design will present from time to time comprehensive articles by authorities in the different fields. Mr. Cosgrove, author of this contribution, heads the Cosgrove Technical Service, Owosso, Mich., consultants to the woodworking trade.

FOR a good many years woodworking machinery did not show any marked improvement. Frames continued to be decorated by scrolls; gears carried rough cast teeth of approximate shape; shafts were of cold-rolled steel; bearings were of cast metal. Design and workmanship competed in respect to crudeness.

During the past two decades, however, great improvement is noted. Improvement not so much in basic, fundamental design as in refinement of design, workmanship and materials. For example: A wood planing machine of today contemplates a revolving cutterhead with multiple knives beneath which the stock is fed by gear driven rolls, just as it was nearly a hundred years ago when Whitney built the first planing machine!

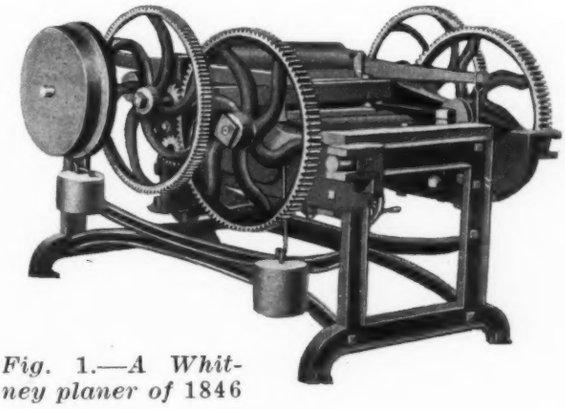


Fig. 1.—A Whitney planer of 1846

But today the cutterhead will be round instead of square; it will be made from heat treated alloy steel and the knives will not number two only—they may be increased to a dozen or more. Knives will be of air hardened high-speed steel about ⅛-inch in thickness. The old welded and slotted knives were three times as thick, but were possessed of less than one-third the life.

Bearings today will be the precision, antifriction type. The cutterhead no longer will be belt driven, but will run at perhaps five thousand revolutions from a direct mounted motor. Gears, where not supplanted by steel chains, will be cut accurately and will run in grease-

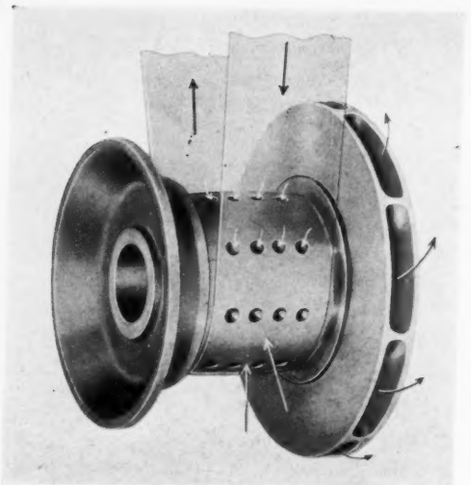


Fig. 3—Suction through holes in pulley increases belt contact

tight casings. Figs. 1 and 2, illustrating a Whitney cabinet planer of 1846 and one of 1930, indicate the progress in design.

It may be stated without hesitation that direct electric drive is employed on woodworking machinery to a greater extent than on any other class of industrial equipment. By direct electric drive is implied that type of drive wherein the rotor of the driving motor is mounted directly upon the arbor or spindle which carries the cutting element, as opposed to the type of drive where motors are coupled, geared or connected by chain to the shaft. Many machines employ multiple motors such as the big double end tenoning machines requiring a dozen or more.

Broadly speaking, the productivity of the majority of woodworking machines is in direct ratio with the rotative speed of the cutting member. Therefore it is safe to attribute the improvement in wood cutting machines to three factors. (A) The direct mounted motors which make possible speeds far higher than those attainable with belted spindles. (B) Spindles of alloy steels running in antifriction bearings competent to cope with the high speeds now in vogue. (C) Thin, hard steel cutters with ability to retain an edge under the extreme conditions of modern service.

Direct mounted, high frequency motors of course provide any reasonable speed wanted and are used on practically all the heavier types of shaping machines. It is not always desirable, however, to install the frequency changers, or the high cycle generating sets, which are necessary for speeds above 3600 revolutions per minute. For this reason there recently has come into extensive use a type of light shaper and router driven from attached, vertical motors by endless fabric belts under delicately adjustable tension. On this class of machine one builder employs "V" frictions of hard fiber (with inbuilt truing device) in place of the belts.

Develops Novel Belt Pulley

Thus speeds of ten or twelve thousand per minute are arrived at readily from a standard sixty cycle 3600 revolutions per minute motor. In such drives one problem is to provide a pulley on the driven spindle of sufficient diameter without attaining excessive belt speed. To cope with the centrifugal pull, which naturally tends to break effective belt and pulley contact of high speed belts, Onsrud has developed a new vacuum pulley as shown in Fig. 3.

This Onsrud pulley is of one-piece cored construction having a flange with a series of openings each of which communicates with a row of holes in the face of the pulley. The theory is that the high rotative speed induces a suction in the cored openings in the flange which, communicated to the holes in the pulley, sets up a partial vacuum tending to hold the belt and pulley in more effective contact.

Medium and heavy service shaper spindles usually are driven at speeds of 7200 to 9000 revolutions per minute by direct mounted motors of four to eighteen horsepower. Fig. 4 indicates the construction of a typical high speed, direct motored shaper spindle (Hall & Brown). Points

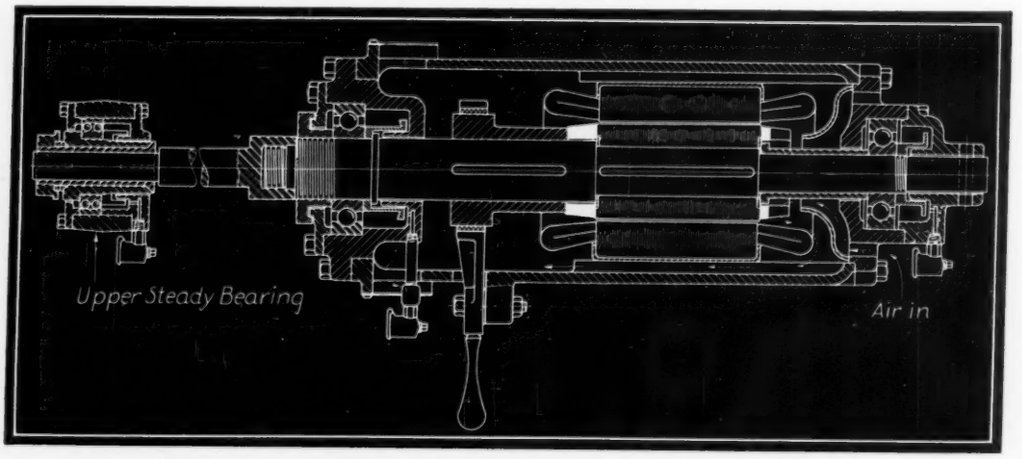


Fig. 4—Shaper spindle driven by motor mounted directly on shaft carrying cutting tool. In the machine the spindle is mounted vertically

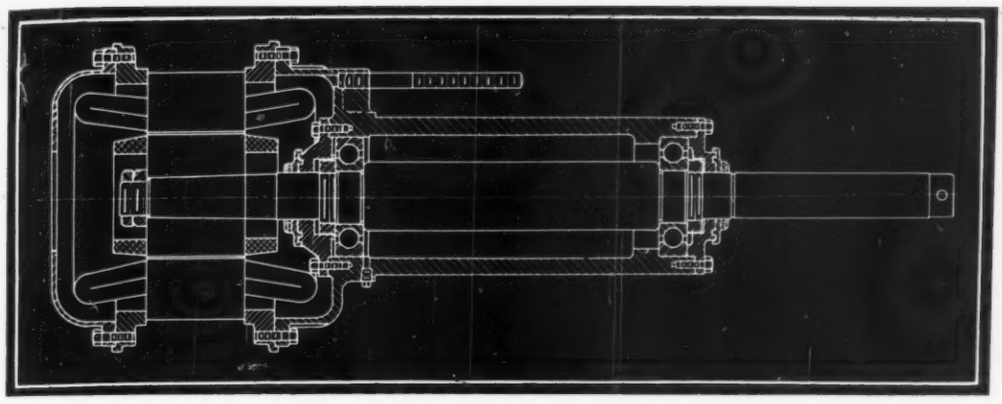


Fig. 5—Concentricity and symmetry are features of the molding machine spindle shown. Note also the accessibility of the motor unit

to be noted in this design are the enclosed, ventilated motor; the deep groove ball bearings; the hand operated brake; oil mist lubrication and the detachable top spindle section with ball steady bearings.

The accuracy maintained in the fitting of a high grade shaper spindle is exceeded in few if any parts of metal working tools. Fig. 6 shows a section of another high grade shaper spindle complete with bearings and rotor of driving motor (Whitney). The drawing does not show the separable top section of spindle. This is located about a foot above the top bearing. As evidence of accuracy it may be stated that the leading builders hold the concentricity of the top section of the shaft to a limit of .00025 to .0005-inch variation.

It will be seen from Fig. 6 that the part *A* serves not only for the motor but also for the upper bearing housing; the lower end being bored concentrically provides a means of locating accurately the lower bearing housing. This construction insures perfect alignment of bearings and motor. The one piece construction of the motor and upper bearing housing makes the slide especially rigid.

Motors Are Cooled by Fan

The motors in these shaper slides are ventilated by means of the fan *B* which sucks air in through the port *C*, blows it against the windings and up between the stator shell and the housing wall. It then comes in contact with the other end of the stator winding and passes out through the exhaust port *F*. It will be noticed that the fan serves also as a ring nut for clamping the rotor in position on the spindle.

In both the upper and lower housings a reservoir *G* is placed beneath the bearing. The oil level is regulated by the filler cup. A wick *J* draws oil by capillary attraction from the reservoir beneath to an oil slinger *K* above the bearing. This slinger is in light rubbing contact with the wick and due to its rotation expels oil from the wick in a fine mist or spray. This mist which permeates the housing lubricates the surfaces of the bearing and eventually drips back into the reservoir where it is ready to be used over again. The wick acts also as a filter preventing any dirt entering the bearing which unintentionally may be introduced with the lubricant through the filler cup. Entrance of dirt is restricted further by seals above and beneath the bearing.

In spite of precautions against undue heating it is impossible to prevent a certain rise in temperature in spindles of this type. The temperature rise will cause a slight expansion of the spindle over that of the surrounding parts. To prevent spindle distortion or overloading of the bearings the lower bearing is made to "float." This bearing *L*, although mounted rigidly to the spindle, is free to move axially in its housing. In addition the springs *N* apply a constant pressure by means of the spring plate *O* to the outer race of the bearing. The pressure

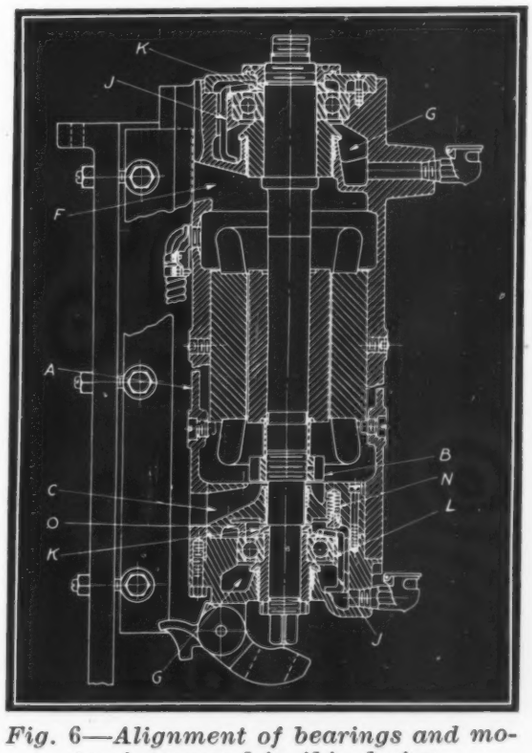


Fig. 6—Alignment of bearings and motor is assured in this design

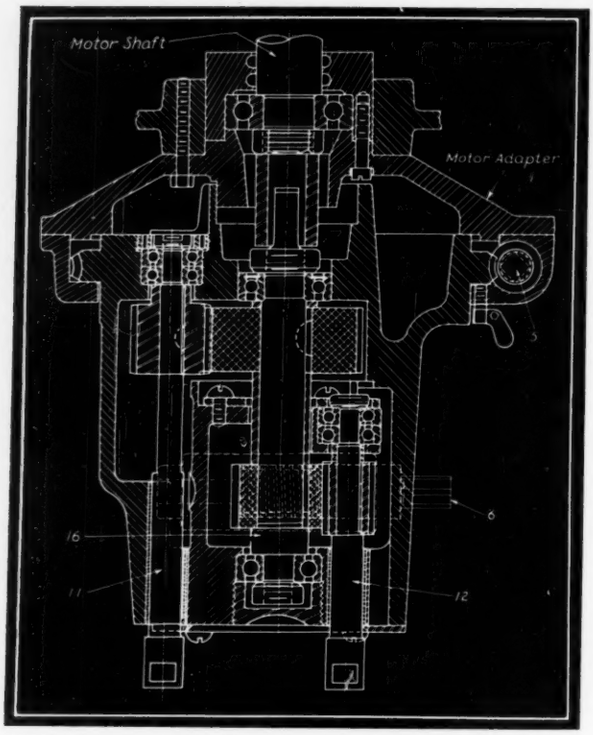


Fig. 7—Two-spindle boring head with wide range of adjustment

tends to crowd the race downward, putting a slight thrust load on the bearing. This load also is communicated to the upper bearing in addition to the weight of the spindle and assembled parts. Any initial looseness there may be in the bearings therefore is taken up and this contributes to smooth spindle operation.

Fig. 5 shows a unique spindle and ten horsepower motor assembly as used by Vonnegut in his electric molding machines. It will be observed that the spindle, bearings and motor are assembled in a self-contained unit and that the shape is cylindrical with all surfaces concentric. The two deep groove ball bearings are located in the one-piece housing with the motor at one end and the cutter head at the other. For cleaning purposes the motor stator may be removed readily. It is located by fitting its recessed flange over the bell end of the bearing housing and is held by four cap screws. The enlarged section of spindle between the bearings is calculated to cope with all whipping tendency of the spindle ends.

Direct Motor Drive Again Employed

Modern saw tables, single or double, invariably are fitted with direct motor driven arbors. This naturally gives the tools much greater positional versatility than would be the case with a belt driven arbor.

A decided tendency toward what might be called multiple machines is noted. If two ends of a piece are to be cut off or tenoned, double end machines are employed and the work completed at one pass. If two sides of a panel are to be sanded, drums are operated above and below the work and both sides are sanded at once. Mortising, boring and similar machines are provided with sufficient spindles and cutters to complete the part at one stroke. In boring there is no need, no matter what the number and layout of the holes, to handle a piece more than once.

Multiple boring machines of vertical type are being produced embodying spindles, driven by universal joints, which may be positioned as required over a considerable area. On machines of this type the spindles may be fitted in any required number.

Many adjustable and nonadjustable boring heads with two or more spindles are being developed. Some of the latter are capable of boring on centers as close as ½-inch. Fig. 7 shows a section through a universal, self-contained, double spindle boring head as made by Oliver.

It will be noted that the housing of this boring head is built directly on to a motor adaptor which is bolted to the end bell of the one horsepower, 1800 revolutions per minute, driving motor. The adjustable boring spindles numbered 11 and 12 are gear driven from the main shaft 16. Main shaft is driven by tang which enters motor shaft. Having no end thrust this shaft is mounted in single row ball bearings.

Rear ends of the boring spindles are mounted in double row ball bearings which cope with radial and thrust loads. Adjustment of spindle centers may be as close as ⅞-inch which precludes the use of ball bearings on front ends. Bronze bushings 3 inches in length therefore are used.

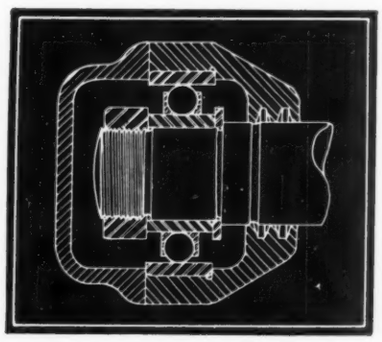


Fig. 8 — Flat race bearing which permits endwise oscillation of shaft, as used on drum sanding machines

Spindles are adjusted by hand crank applied to square heads 5 and 6, from the minimum of ⅞-inch to a maximum of 3½-inch. Holes may be bored on a vertical, horizontal or angular line. Spindles run at 3500 revolutions per minute and take screw shank bits. Ball bearings are lubricated by grease, bronze bushings by oil and gears by a heavy oil.

In Fig. 9, at *A*, *B* and *C* is depicted an endless infeed bed as patented by Woods for use on his electric molders. This endless bed, replacing as it does the line contact of feed rolls by a liberal

surface contact, makes for a powerful feed without undue roll pressure. Note at *A* the side link of the roller chain to which is riveted the mounting bar. To this is riveted in turn the serrated cross bar which contacts the stock being fed. Note also at *B* how the pressure is carried on rollers which travel on the two supporting rails. The assembly drawing *C* indicates the almost complete absence of cocking as the cross bars start downward on the sprockets.

Difficulty Created by Endwise Movement

Drum sanding machines of the power feeding type present some bearing and motor mounting problems which are peculiar to themselves. In this type machine the drums have an endwise oscillation of ¼ to ⅜-inch for the purpose of eliminating scratches on the work. Formerly this oscillation complicated the direct mounting of the drum driving motor. However it recently has become recognized as good practice, mechanically and electrically, to allow the rotor to oscillate within the stator; in other words to forget the slight oscillation.

The matter of mounting the antifriction bearings of the drum shaft in such manner as to permit endwise oscillation of the shaft is however a problem which is not disposed of so rapidly as the motor mounting. Various methods of mounting the bearings are in use. In some machines the bearing is clamped to a sleeve through which the drum shaft slides. In a variation of this method the outer race is mounted on a sleeve, which sleeve is permitted the required endwise motion.

A third method involves the use of flat race roller bearings permitting endwise movement between the rollers and races. Fig. 8 shows a method which is patented by Yates-American. It will be observed that this embodies a special

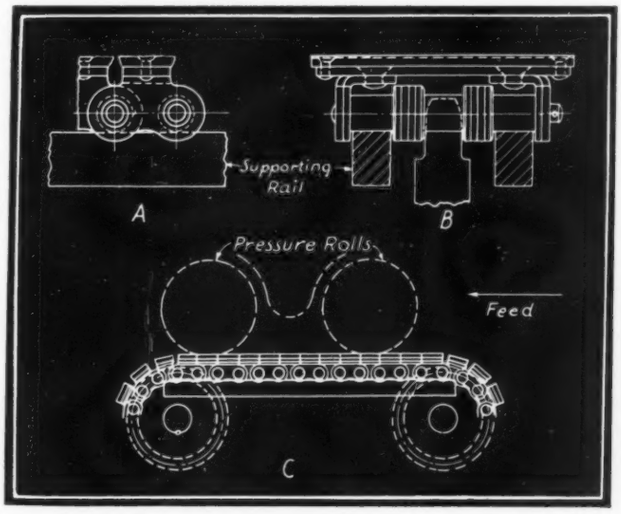


Fig. 9—Three views of endless feed bed. Formerly feed rollers were used

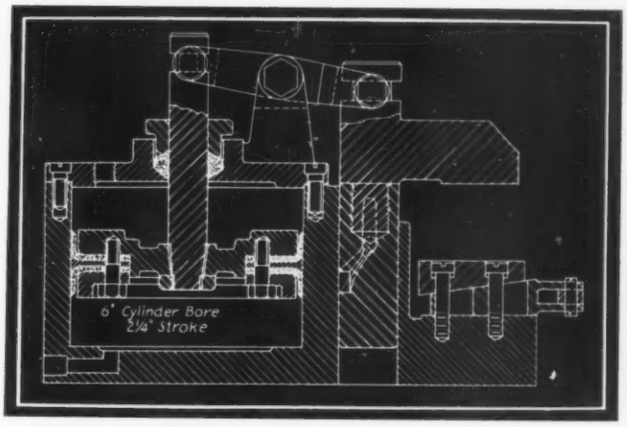


Fig. 10—Air operated clamp suitable for mounting on machine bed

flat race ball bearing providing frictionless operation both radially and axially.

Fig. 10 shows an air actuated stock clamp by Logansport. Clamps of this type are coming into more and more general use on woodworking machines for holding the stock in position for the cut. The operation usually is automatic, in step with the strokes of the table or spindle. The body of this clamp consists of a semisteel casting with the main clamping cylinder, of 6-inch bore and 2¼-inch stroke, cast integral.

A cam is provided which serves to rotate the clamping jaw 90 degrees on the upstroke thus leaving the fixture wide open for reception and discharge of work. Wedge plates will be noted at the bottom of the fixture which are operated by an independent air cylinder of 2-inch bore and ⅛-inch stroke. These wedge plates are employed where two or more clamping fixtures are used in one setup for the purpose of providing a true clamping surface for the holding of irregular work.

Adopt Air and Hydraulic Feeds

Onsrud and Defiance are using compressed air feeds on some of their machines with a great deal of success. Yates-American and Northfield are fitting hydraulic feeds for such machines as large multiple borers and chain saw mortisers. Air clamping and pressing devices of many sorts rapidly are displacing the old screw presses and clamps. Hydraulic veneer presses have superseded almost completely the screw presses formerly employed.

Electric motor control and protection apparatus as applied to modern woodworking machines is complete and effective. Machines such as the large double end tenoners with a dozen or more motors are of necessity fitted with enclosed switchboards. Push button control is universal with master push buttons for simultaneous control of all motors. The Whiting company has just announced a new electro-dynamic brake for its shaping machines.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

INDUSTRIAL applications of the photoelectric cell, popularly known as the electric eye, are broadening at an extremely rapid rate. Many of the applications already are comparatively well known, including its employment for detecting flaws or defects in material, inspecting and sorting finished articles, operating safety devices, bringing into action reversing mechanisms, stopping machines or ringing an alarm on paper machines when breaks occur in paper, etc.

Recently another development was announced in which the cell is used for operating the paper cut-off knife on a wrapping machine at such time as the printing on the paper reaches a certain point. In other words, given correct spacing of the printing on the paper, the latter will be cut off at uniform intervals and each sheet will bear exactly the same printed matter.

It will be observed that none of the foregoing examples cover employment of the "eye" for detecting variations in color. Experiments have been carried out, however, for some time to adapt the cell to this use, and now a new machine called the Colorscope has been developed which is intended for the matching of colors of paints, textile goods, liquids, etc. An illustration of the machine, developed by Dr. H. H. Sheldon, New York university, and announced by Sheldon Electric Corp., 100 Fifth avenue, New York, is shown in Fig. 1.

Two photoelectric cells are used in the Colorscope, in front of which are placed the materials to be compared. Being extremely sensitive to light changes, any variation in depth is detected and indicated by a galvanometer which is inserted in the electric circuit with the cells. Thus, if the material is lighter or darker than the standard to which it is being matched, the pointer will swing to left or right of zero. There is no direct relation between the light energy acting on the cells and the intensity of the current on the galvanometer circuit, therefore the device indicates not only that there is a difference in shade, but the amount of the variation.

Fig. 1—Machine incorporating photoelectric cells for color matching

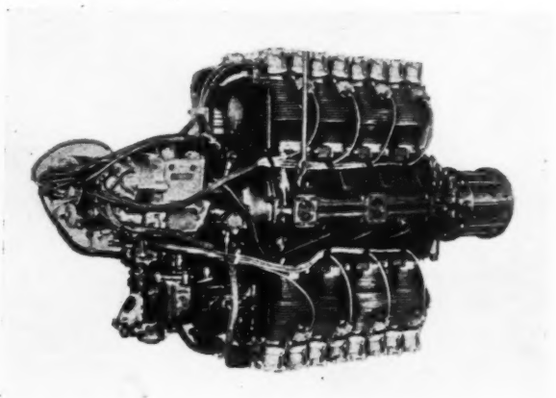


Fig. 2—Airplane engine in which two crankshafts are geared to propeller shaft

Engine Incorporates Two Crankshafts

OF UNUSUAL design is the engine illustrated above in Fig. 2. It has been developed by the Napier Co., England, and possesses the advantage, particularly for aircraft use, of low

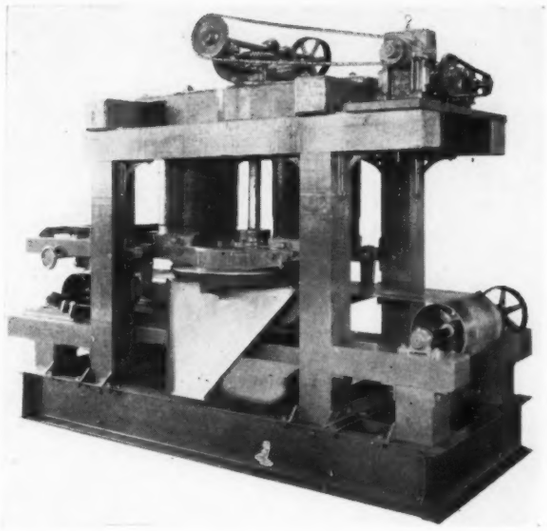


Fig. 3—Magnetized ring separates material passing beneath on conveyor belt

wind resistance. It also gives the pilot comparatively clear vision by its unique arrangement of cylinders.

The 16 cylinders are arranged in four rows, two rows being parallel above the crankcase and two below. The engine therefore is referred to as the H-type. Overhead valves operated by push rods are employed.

In the double crankshaft design which is incorporated in this engine, each set of upright and inverted cylinders on left and right hand sides of the crankcase have a common crankshaft. These are geared to the shaft of the propeller boss. This use of double crankshafts in engines and machines is becoming more widely used and the day may not be far distant when engineers in many fields of design will give serious consideration to the adoption of this idea in their designs.

Magnetized Ring Separates Materials

SEPARATION of materials by the magnetic method is emphasized by the announcement of a new machine for this purpose, designed by the Magnetic Mfg. Co., Milwaukee and shown in Fig. 3.

A number of interesting features are incorporated in the design. The material to be treated is passed through a special hopper at the feeding end of a conveyor belt which distributes it evenly over the belt. It then passes under a revolving, highly magnetized ring which seizes all magnetically responsive material, moving it over and away from the nonmagnetic material and discharging it onto chutes at the side of the separator. The construction is such that the magnetized ring becomes neutralized as it revolves over the discharge chutes, automatically releasing the magnetically separated material.

In order to change the magnetic intensities for different materials the entire magnet assembly, weighing 12,000 pounds, is designed as an integral unit thus permitting adjustments within the frame of machine. The magnetic ring is fitted to a bronze disk actuated by a shaft driven from an individual motor and speed reduction unit.

Rubber Tires Used on Sand Muller

A DISTINCT departure from orthodox design is noted in a foundry machine introduced recently for mulling sand. Some of the earlier machines for this purpose were made in circular form, the container for the sand rotating in order to pass the material beneath the mulling wheels. In the design shown in Fig. 4, however, the process has been reversed and the sand passes continuously in a straight line under rotating wheels. This machine was developed by Beardsley & Piper Co., Chicago. As will be seen from the illustration it consists essentially of three parts, an endless apron conveyor, the muller and a sand storage hopper.

Worthy of note is the fact that the wheels are provided with a heavy rubber-tired tread for gripping the sand and mulling it, giving a better action than steel wheels which rapidly become smooth and may skid over the sand instead of mulling it. It is generally accepted that rubber lasts longer than steel where abrasive action of this kind is concerned. In support of this might be cited the case of motor trucks with tire service of 15,000 to 20,000 miles of tire service under heavy loads—a much more severe condition than would be encountered in the sand muller or similar machines.

The tires are secured by means of four hold-

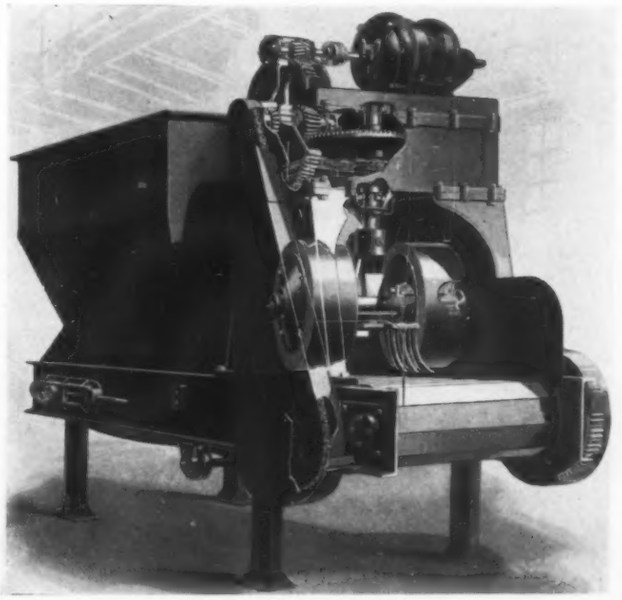


Fig. 4—Unconventional design of sand muller embodying rubber-tired wheels

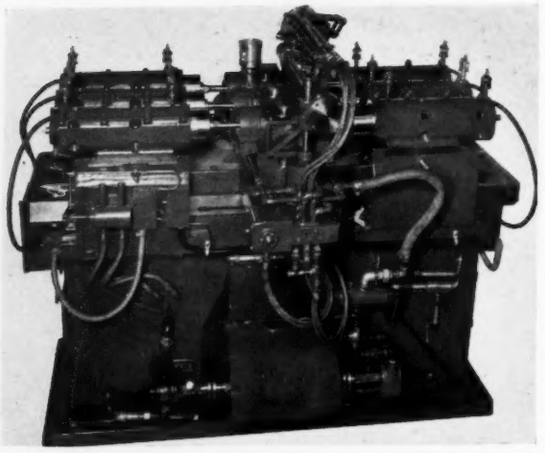


Fig. 5—Boring machine in which each spindle has individual built-in motor

ing lugs identical to standard automobile practice and may be removed and renewed easily when desired.

Three strands of heavy roller chain, secured to the steel apron by attachment links, are used in the construction of the conveyor. The tops of the steel aprons are protected by ⅜-inch wearing plates so made as to be renewed easily if worn.

The sand muller is automatic in operation as the sand is conveyed into the storage hopper by elevator or conveyor from the sand system and returned to the system from the discharge end of conveyor.

Boring Heads with Built-In Motors

IT WILL be noted from other pages of this issue of MACHINE DESIGN that the built-in type of motor rapidly is becoming more widely recognized as a means of applying the power directly to the work, particularly on certain types of woodworking machines and machine tools where the rotor can be mounted directly on the arbor or shaft carrying the cutting tool.

An interesting example of this construction is contained in the design of a boring machine developed recently by the Ex-Cell-O Aircraft & Tool Corp., Detroit. The machine is illustrated in Fig. 5 which shows the setup for piston boring. From the illustration it will be seen there are six boring heads provided on the one machine. Three spindles at one end carry roughing tools while the other three are equipped for finishing.

Each spindle has its individual built-in motor, rated ¾ horsepower, 3600 revolutions per minute. The spindle brackets have large bores, finished the entire length, and each bracket is split on a 45-degree angle for locking in place by clamping screws the spindle housing, motor stator and rear bearing housing. By this method of mounting the boring unit, all parts are clamped rigidly in position insuring alignment of parts. Another pertinent feature is that spare spindles with tools set to size may be interchanged with minimum shut-down time for the machine.

The hydraulic principle plays an important part in the design of this machine. Not only are the feeds operated hydraulically but the clamping mechanism for holding the work also is actuated by this method. Operating pressure of 100 pounds per square inch is used. The manual control valve for starting and stopping is located in the center of machine for convenience of the operator, and by means of this valve the machine may be stopped at any point in the cycle of operations without disturbing the automatic cycle of the machine. The spindles on each bridge are equipped with limit switches and individual hydraulically operated brakes. When the cut is completed and the table ready to reverse, the limit switch is disconnected and the brakes applied, stopping the spindle, while the work returns and the cutting tool is backed out of the work.

Is Independent Springing Coming?

AN UNUSUAL type of automobile spring suspension is discussed in an article which appeared recently in *Automotive Industries*. It is employed in the Lancia Dilambda car and is a refinement of a similar device used by the Lancia company for some years. Fig. 6 shows a cross section through the steering head of the car. The steering knuckle is formed with an eye at its inner end which surrounds a hollow spindle capable of sliding vertically in two steel thimbles secured into the upper and lower arms of the steering yoke respectively. The weight supported on the front wheel is transferred from the steering yoke to the knuckle through a

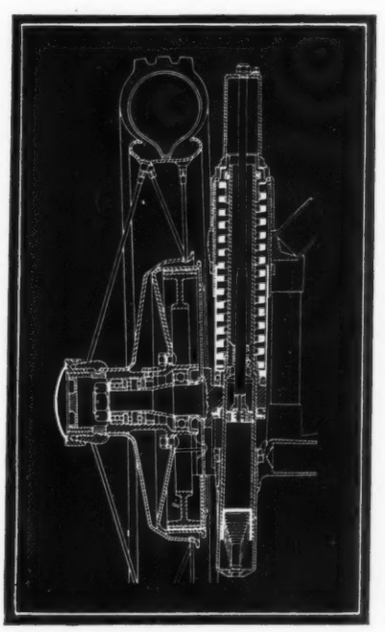


Fig. 6. — Cross section through steering head of European car in which independent wheel springing is incorporated

coiled spring located inside the thimble in the upper arm of the steering yoke. There is an additional, volute-type of spring in the thimble in the lower arm of the yoke, which acts as a counter spring and limits recoil.

A hydraulic shock absorber is built directly into the steering knuckle. It will be observed from the drawing that there are two chambers in the knuckle, containing the main spring and the counter spring respectively. These chambers are filled with oil, thus producing a satisfactory damping action.

One-Point Chassis Lubrication

AMONG other interesting developments in the automotive field is the application of a one-point method of centralized chassis lubrication to cars built by the Reo Motor Car Co. The system has been developed by Lubrication Devices Incorporated, Battle Creek, Mich., to operate at high pressure and distribute heavy lubricant to all points of the chassis from a single source.

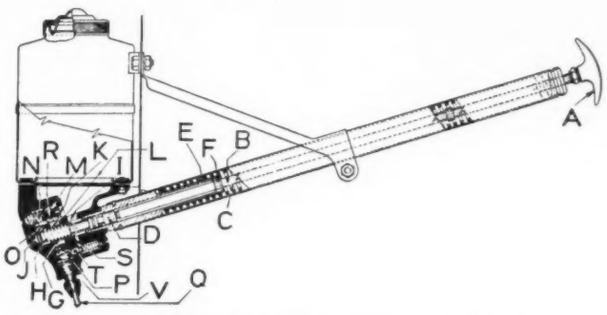


Fig. 7—Section through pumping unit of one-point chassis lubricator

The system consists essentially of a central reservoir, one-quart capacity, and a compressor to distribute the lubricant. Positive metering valves are located at each bearing to provide delivery of a predetermined quantity of lubricant.

In the pumping unit, shown in Fig. 7, a handle is provided which can be operated conveniently from the driver's seat, the unit being mounted on the car chassis to bring the handle close to the steering column. To operate the pump it only is necessary to pull forward the handle and release it immediately, this bringing into action a series of valves and springs which commence the distribution of the lubricant.

Coin Machines for Delivering Gasoline

POSSIBLY an offshoot of the automatic gum machine, coin-in-slot gasoline pumps now have made their appearance. The pumps are known as "Gas-O-Mat" and have been in use

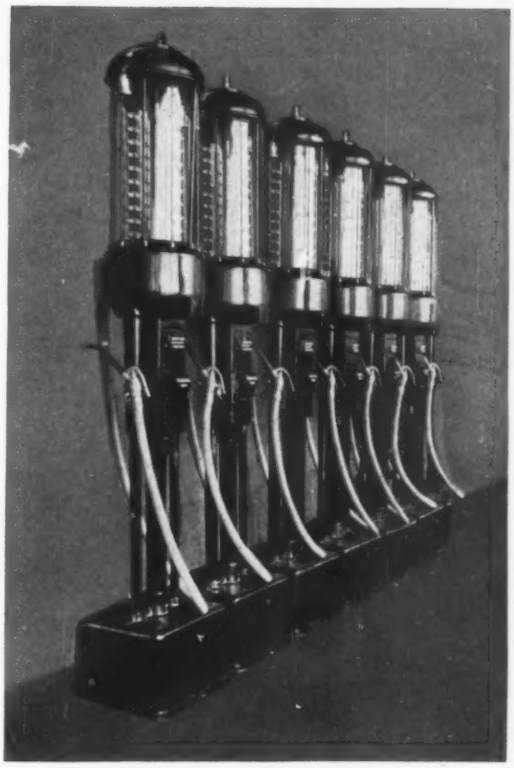


Fig. 8—Automatic coin-in-the-slot gasoline pumps for service stations

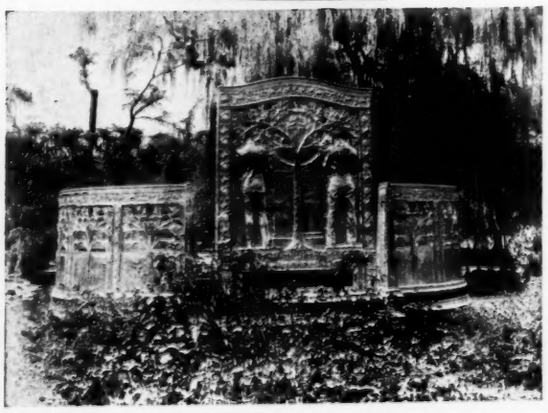
in Colorado for a sufficient length of time to prove their adaptability in meeting modern day needs of the motorist. A group of the new machines is shown in Fig. 8.

Advantages of this type of unit are of course that gasoline can be purchased at any hour; accurate measurement always is given; and there is no possibility of delay in awaiting change, etc. Salaries of employes also are saved by the station owner, the only attention necessary being to make adjustments to the mechanism in accord with gasoline prices.

The pumping unit installed in each machine is small, being driven through Link-Belt silent chain by a ¼-horsepower motor running at 1725 revolutions per minute.

TO RELIEVE street car passengers of the necessity for keeping constant look-out for their destinations or of relying on the conductor for this information, a device has been patented in England to indicate the name of the station or stop the car is approaching.

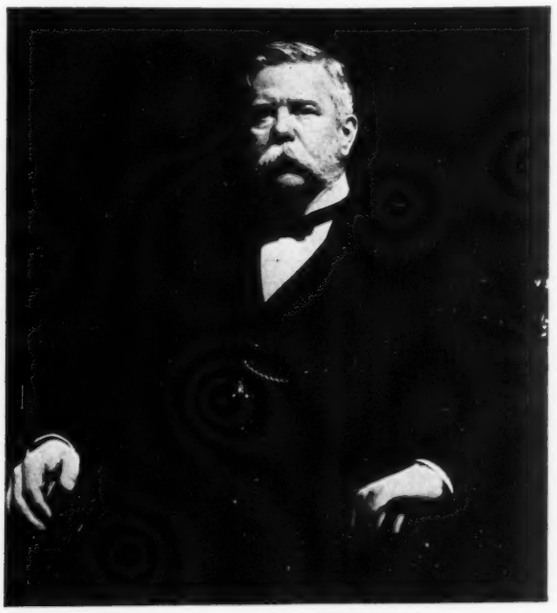
On the trolley of the car there are two small shoes which make contact at each stopping place with a live rail fastened to the trolley wire. The current energizes coils controlling the motors driving the mechanism of the indicator board, the connections being made through the driver's controller whichever way the car is traveling.



Tribute to Inventor

SURROUNDED by natural beauty, an imposing memorial now stands in Schenley park, Pittsburgh, in honor of the late George Westinghouse whose inventive genius won him unprecedented recognition. At the recent dedicatory ceremony during which the bronze monument was unveiled, the nation's leaders gathered there to pay homage to the man who contributed so largely to the engineering progress of the world.

Accompanying views show the semicircular grouping of the panels, one large 20-foot bronze panel in full relief, flanked on either side by two panels of smaller size. The inscription, "Empire Builder," characterizes George Westinghouse, whose portrait appears below. Besides his invention of the air brake, the railway switch and signal system, he developed the combustion engine and steam turbine. Another achievement in his illustrious career was his attainment in establishing a practical use for alternating current.



Photoelasticity—and Its Application in Design

By R. V. Baud

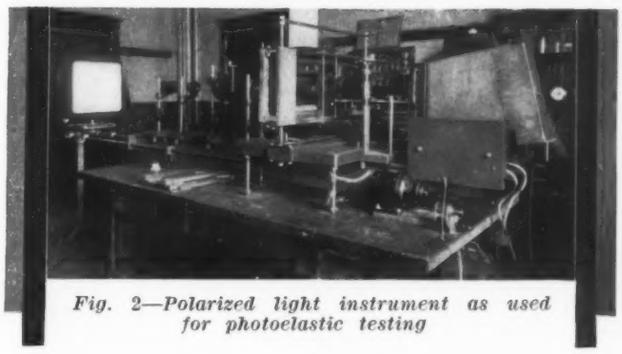


Fig. 2—Polarized light instrument as used for photoelastic testing

IN JUDGING the safe load of a structure the designer often bases his conclusions primarily upon service records. If increased loads are applied to a given structure, or if a design of a structure is radically new, he is confronted with the fact that no service records exist. There are, however, two other means of evaluating the safe load in such a case.

One of these methods consists of combining all factors involved in a destruction test. Such an experiment has a disadvantage in that it does not indicate how a design may be improved, unless a series of tests is made in which certain details are varied.

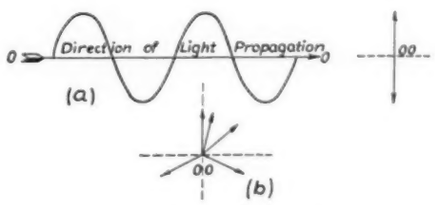


Fig. 1—Showing propagation and vibration of (a) polarized light; (b) unpolarized light

The other method consists of securing information regarding the stress field, the physical data of the materials employed, and of applying that theory of strength which takes best into consideration the peculiarities of the problem. In solving a problem thus, weak spots in design are unearthed.

AS a means for observing and obtaining information on stresses in machine parts, the photoelastic method is becoming prominent. R. V. Baud, research laboratories, mechanics division, Westinghouse Electric & Mfg. Co., describes the system in this the first section of a three-article series. In later contributions he discusses researches of his company in this field, and how the results are applied.

In securing stress field information the designer again has two methods from which to choose. The first method consists of computing the stresses analytically. However, textbooks on the strength of materials do not contain sufficient information on how to compute the stresses in all points of a complicated structure. In fact, many books contain only an elementary discussion of problems that involve the computation of stresses in certain points of simple structures such as prismatical bars. But actual machine parts as a rule are much more complicated in shape than such bars and therefore the stresses computed from the formulas given in such books should be considered as rough approximations, which may require factors of safety as large as 4, or even larger.

For a limited number of cases involving simple shapes and simple systems of forces, strict solutions have been obtained by mathematicians on the basis of the exact theory of elasticity. In these cases the designer can reduce the factor of safety so as to approach unity provided actual conditions in service correspond to the conditions assumed by the mathematicians in the deduction of their equations. This is seldom the case, therefore these solutions are not of real help to the designer.

We can summarize the analytical method of computing stress by saying that on the one hand the designer cannot quite trust the safe load value as computed from formulas given in books on the strength of materials, even though large factors of safety are included, and on the other hand, exact solutions if possible at all are far too complicated to be derived in the course

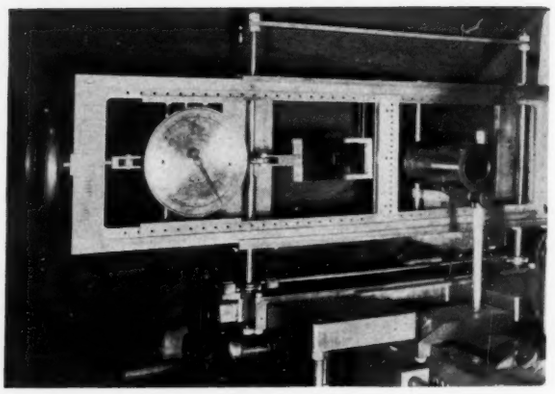


Fig. 3—Loading arrangement. A model of the part is inserted and a force representing load is applied

of the design of a machine or any other structure.

The second and more practical way of obtaining stress field information consists of making so-called photoelastic tests, and to provide that the designer gets easy access to the results of such tests, which give complete and accurate data in at least two-dimensional problems. In the case of three-dimensional problems the results will be approximations only, which nevertheless are of considerable value in a great many cases. The object of this article is to make the designer familiar with this remarkable tool for studying stress problems, and also to present certain results obtained with it.

Elements of Photoelastic Testing

A model of the machine part is made from a flat sheet of suitable transparent material, preferably ¼-inch thick. This model is loaded by an arrangement so designed that measurable forces can be applied to the model in a manner similar to service conditions, Fig. 3. Model and loading arrangements are inserted into a polarized light equipment of the type shown in Fig. 2. The room is made dark and the lamp of the equipment turned on. The beam of light is made parallel by means of a system of lenses so as to go perpendicularly through the model and to project the model on a screen.

Optical parts are so arranged that practically no light reaches the screen, if the forces applied to the model are zero; the image of the model therefore appears black for zero load, the contour of the model scarcely being visible. On the other hand, if the load applied to the model has a definite magnitude, its image shows bright color fringes and it stands out against the black field with well defined contours. A change in the magnitude of the load within limits does not change the shape of the fringes but merely their color. In releasing the load the original image reappears.

The colors observed are the so-called "interference colors of the crossed Nicol arrangement" and are obtained due to the fact that polarized light, obtained by means of polarizing prisms and quarter wave plates, is employed in these observations.

Light is said to be polarized if the light vibrations take place in a well defined manner. If all vibrations are restricted to one plane, the plane of the paper, for instance, then the light is said to be plane-polarized. (See Fig. 1-a.) If on the other hand the direction of light vibration is at random, as is indicated by Fig. 1-b, the light is unpolarized.

Lines of equal color are the locus of points for which the difference $(p\text{-}q)$ is constant, whereby p and q are defined as follows:

Definition: Stresses S_1, S_2 acting at certain angles α_1, α_2 to the normal of an element as shown in Fig. 4-a have two extreme values p, q for a certain angular position of the element, in which position α_1 and α_2 are 90 degrees, i.e., there

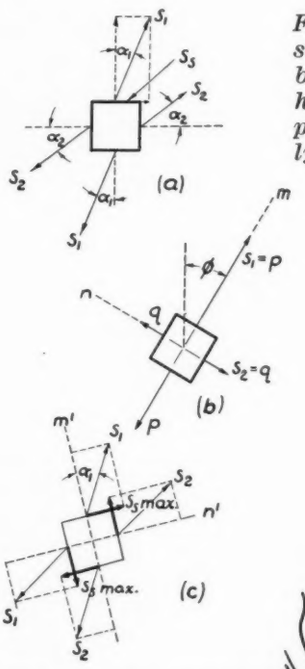


Fig. 4—(a) Stresses S_1, S_2 acting on element oriented at random; (b) element oriented so that S_1, S_2 are principal stresses; (c) shear stress S_s is the principal shear stress $S_{s\ max}$

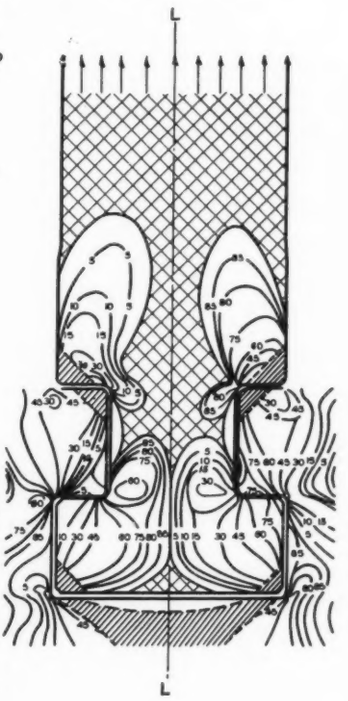


Fig. 5—Isoclinic lines observed in root of turbine blade. In double cross hatched area the principal stresses are practically perpendicular to center line L-L

are only normal, but no shear stresses acting on the element in this particular position, see Fig. 4-b. These extreme values p and q of S_1 and S_2 are called *principal stresses* and the axes m and n are called *principal stress directions.*

The shear component S_s has a maximum value $S_{s\ max}$ for a certain angular position of the ele-

ment, which is obtained by rotating the element from the position (4-b) through an angle of 45 degrees into position (4-c). The shear stress for that particular position is called the *principal shear stress* and the axes m', n' are called *principal shear stress directions.*

The principal shear stress as defined above depends upon the principal stresses p and q as is given by equation (1)

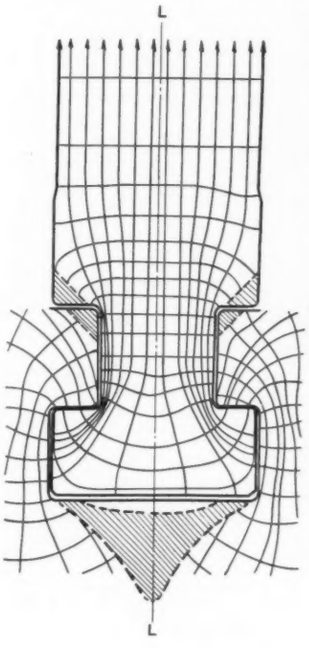
$$S_s \text{ max} = \frac{p-q}{2} \quad \text{.....(1)}$$

It was mentioned that lines of equal color are lines along which $(p\text{-}q)$ is constant; therefore, since $(p\text{-}q) = 2\ S_s$ max., it is seen that lines of equal color are lines along which the principal shear stress is constant.

The representation of stress conditions as shown in Figs. 4-a to 4-c and also in Fig. 8, element 1, may not be familiar to all designers, because most books do not treat the subject in this fundamental manner. In these books the definition for principal stress is omitted generally; they convey the impression that there is only one stress acting as indicated in Fig. 8, element II. Such a condition where a rectangular element is subjected to one stress only is very rare, except for free boundaries in two-dimensional problems. In such boundaries there is no material outside of the body to take up stresses acting in the direction perpendicular to the boundary, element III, Fig. 8.

In order to obtain a permanent record of the color fringes, a color or ordinary black and white photograph can be made, an example of which is given in Fig. 7. This photograph was obtained from the experimental set-up shown in Fig. 3. The model tested represents the root of a turbine blade.

Fig. 6—Principal stress direction lines as obtained from the map of isoclinic lines shown in Fig. 5 on previous page



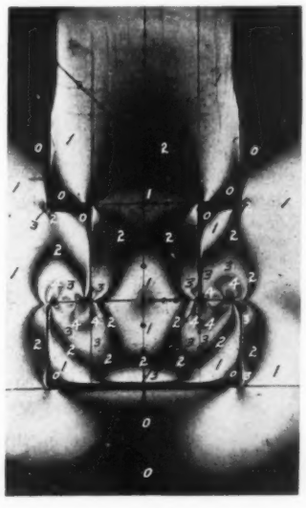


Fig. 7—Photograph of isochromatic lines in root of turbine blade. Lines of equal shade are lines on which principal shear stress is constant. Stress increases with numbers given

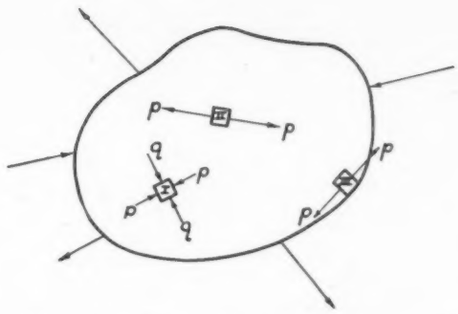


Fig. 8—Two dimensional part subjected to system of external stresses. Element I shows true condition, and element II an assumed, simplified condition of stress. Element III indicates there is only one principal stress acting tangentially to free boundaries

Dark Bands Cross Color Bands

When the quarter wave plates are removed, the image of the model is somewhat altered, in that blacks bands crossing the color fringes appear. By connecting points of the absolute darkest portion of the bands, the so-called isoclinics are obtained. Isoclinics are lines along which the angle ϕ in Fig. 4-b is constant. By rotating either the model or the Nicol prism the black bands shift, whereas the color fringes remain unaltered. By drawing for each position the isoclinics observed, a map such as shown in Fig. 5 is obtained. For any point along the line marked 5, for instance, the angle between one of the two principal stress directions m, n and the center line L-L is 5 degrees, measuring the angle off in counter clockwise direction in this case.

Fig. 6 conveys the same information as Fig. 5 but in a somewhat different manner. The curves shown in Fig. 6 are principal stress direction lines. They are drawn so that at any point the tangent to the curves gives the principal stress direction at this point.

From photoelastic sets such as shown in Fig. 2 the stresses in free boundaries are obtained directly. For points inside, the difference between the principal stresses is obtained, instead of their magnitude separately. However, analytical methods have been worked out to separate p from q on the basis of the available photoelastic data.

Mr. Baud's second article of his series contains interesting information on research work carried out in this field for some years.

Applying Silent Chain Drives

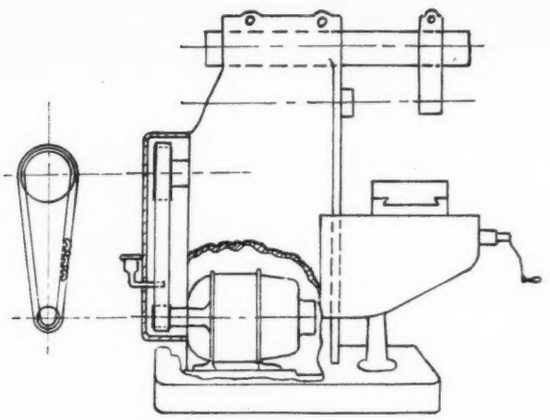


Fig. 2—Sketch showing individual built-in motor and drive on milling machine

By J. H. Groom

APPLICATION of individual motors to machines brings to the forefront the newer forms of power transmission. In the accompanying article J. H. Groom, engineer with Morse Chain Co., Ithaca, N. Y. deals with the silent chain drive and gives much information of pertinent value to engineers responsible for the design of machinery.

SILENT chain drives often have been classed with general power transmission devices and placed in the same category with belts, pulleys, etc., in the millwrighting or plant engineers department. But in this day of self-contained machines, the installation of chain drives has become a matter for the attention of the machine designer, and the drive itself often becomes an integral part of the machine. Therefore, it is believed, that a discussion of silent chain drives at this time will be of some value to engineers responsible for design.

Chain drives as applied to machines seem to divide into two general classes, first, those which connect the machine with its source of power, generally an electric motor; and secondly, those which are used to transmit power within the machine itself and which may be termed "Auxiliary Drives."

A decade ago, machines generally were designed for belt drives from a countershaft, and when an individual motor application was ordered by the customer it was treated as a special job; the motor was attached to the machine in the best way possible under the circumstances. Later, machines were designed so that the motors could be mounted more conveniently and pads were provided on the frames of the machines to receive suitable mounting brackets, the power being transmitted from the motor to the machine itself by means of a belt or silent chain drive, belt drive or direct motor drive being optional with the customer. The countershaft disappeared, and with it the various friction clutches for starting and stopping the machines; also the cone pulleys for speed changing that were mounted on it. These functions were built into the machines, resulting in neater and more efficient machines and lighter and safer shops.

Fig. 1—Drip type oiler mounted on side of chain case. Drives in such instances need not be totally enclosed

Direct Drives Becoming Popular

Today the tendency is to go still further and many machines are built as motor driven units. In fact, many machine manufacturers build the main drive motor right into the machine and in some cases use several auxiliary motors which provide the necessary power at the points where it is needed. This tendency in design doubtless will receive considerable impetus when the new N. E. M. A. standard motors come into general

use, when all makes of motors of a given horsepower, speed and voltage will have the same mounting dimensions, shaft diameter, etc. It then will be a much simpler matter to provide a suitable place partially within, or entirely within the machine to receive a motor of the necessary rating.

Electric motors usually operate at a fairly high rate of speed and the silent chain drive provides a satisfactory and efficient means of

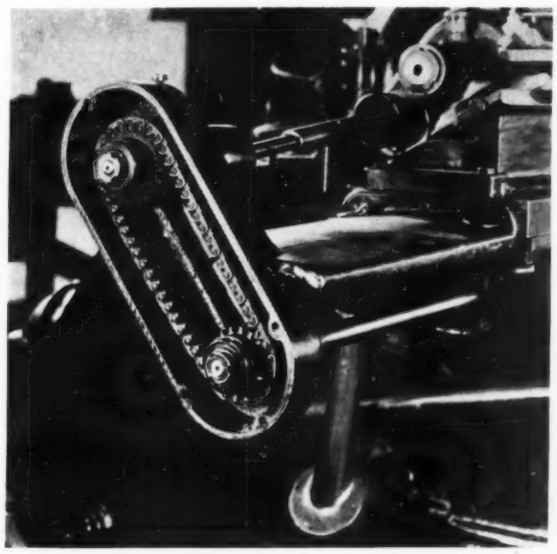


Fig. 3—Enclosed silent chain drive to universal joint shaft. (Cover removed)

reducing the speed as well as transmitting the power to the machine. The chain combines the positive action of gearing with the flexibility of a belt, provides a smooth and even flow of power, and has an efficiency of over 98 per cent.

The standardization of the motors also will result in the standardization of chain drives for a given machine, permitting the manufacturers to carry a stock of standard drives on hand, thus facilitating delivery and cheapening production. Fig. 2 shows an example of built-in motor and silent chain drive.

Silent chains are available in a great variety of pitches and widths, ranging, particularly in the Morse chain series, from 3/16-inch pitch, 3/16-inch wide chain used in movie cameras, to the 3-inch pitch, 30-inch wide chain used on heavy drives and water power installations. Detailed information for the proper design of drives is given in most of the chain manufacturers' data books. While engineers are urged to obtain copies of these booklets, there are a few general rules that profitably might be stated at the present time.

In general, large pitches are used when heavy power at comparatively slow speed is to be transmitted, and the smaller pitches for the lighter power and high speeds. If extra smooth or quiet running is desired, the smaller pitches should be favored, compensating for the power by adding width to the chain. Vertical drives should be avoided and an angle of at least ten degrees provided whenever possible. It is preferable to have the slack in the strand of chain which is at the greatest angle from the vertical. When the center line of the drive is horizontal, or at an angle of less than 45 degrees, the slack strand of a chain may be either the upper or preferably the lower strand, and should the centers be comparatively short and reduction small, it is advisable to have the slack on the lower strand of the chain. In the case of a drive with comparatively long centers, it also is preferable to have the slack on the lower strand, as otherwise there is danger of the two strands rubbing together. Adjustment should be provided to take up the slack of the chain, especially on vertical or nearly vertical drives.

Even Number of Links Desirable

It is desirable to keep an odd number of teeth in both sprockets and an even number of links in the chain, as this combination results in long life. When it becomes necessary to use a chain with an odd number of links, a hunting link must be used to provide proper connections. While pinions with as low as thirteen teeth can be used, it is better to use not less than seventeen teeth where the ratio and other conditions permit. The driving sprocket should be proportioned to give a chain speed of not more than fourteen hundred feet per minute as a general practice. While much higher speed than this can be used on some classes of work, this should be done only on the advice of the chain manufacturers.

For most drives, given the horsepower to be transmitted, and speeds of driving and driven shafts, it is possible to design a chain drive using several different combinations of teeth, pitch and width. Usually one design is superior to the others and will give the maximum service per dollar of cost.

Every drive should be designed for its own

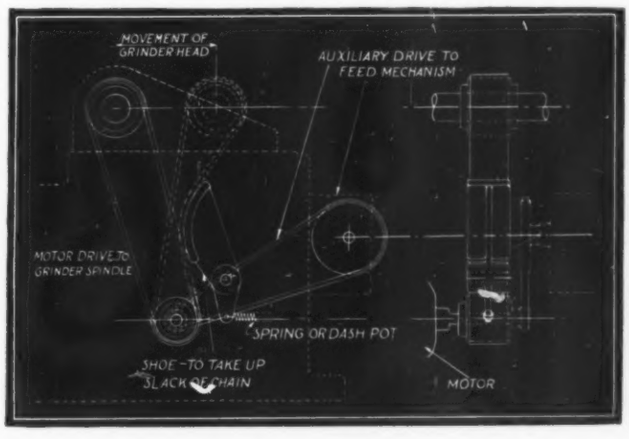

MOVEMENT OF GRINDER HEAD
AUXILIARY DRIVE TO FEED MECHANISM
MOTOR DRIVE TO GRINDER SPINDLE
SPRING OR DASH POT
SHOE TO TAKE UP SLACK OF CHAIN
MOTOR

Fig. 4—Arrangement of main and auxiliary drives on precision grinding machine

particular service. Consideration must be given to the horsepower, speed of driver and driven shafts, center distance, and also to the nature of the work required, and to such of the surrounding conditions as may affect the drive. The design of the drive will comprise the selection of proper pitch, number of teeth in each sprocket, and correct width of chain to transmit the required horsepower.

Selection or design of a drive to fit the specified conditions is not difficult, and the selection of sprockets of suitable size with chain of correct width and pitch is a simple matter. However, the need for exercising judgment is never absent and it is for this reason we believe that consultation with chain driving specialists always is advisable and absolutely necessary in the case of unusual drives exceeding standard limitations.

Lubrication Should Be Considered

Provision must be made for the proper lubrication of the chain and if this can be accomplished automatically, so much the better. Many machines today have built-in automatic oiling devices, and doubtless in many cases these can be extended to include the chain drive. There are several other ways to provide constant automatic lubrication. One consists of the use of a sheet metal disk mounted on the same shaft as the pinion or sprocket and dipping in oil. This disk acts as a slinger and throws a sufficient amount of oil into a suitable catcher, the oil being conducted to the inside through a small pipe. Another way is to provide a ring running in a groove in the hub of the sprocket and which dips in oil. This ring picks up a certain amount of oil which is caught in a trap or catcher, and conducted to a chain in a manner similar to that described above. When this scheme is used, sprockets are made with slightly longer hubs than usual to provide room for the groove for the ring oiler. Another way is to let the slack side of the chain dip in oil, but this is not recommended when the chain travels at a high rate of speed.

When the motor is on the outside of the machine, it often is necessary and desirable to provide a sheet metal case over the chain. These cases may be purchased with the drives and can be equipped with any of the automatic oiling devices described in the foregoing, or with a simple oiler as shown in Fig. 1.

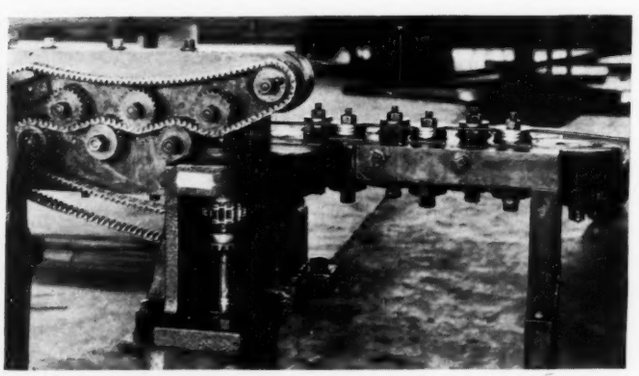


Fig. 5—Application of special duplex chain with teeth on front and back

In the design of a machine it frequently occurs that the power is required at a point somewhat remote from the main drive of the machine. A silent chain drive again offers a convenient means of transmitting the power required to the point of its use. Fig. 4 shows the arrangement of the drives of a precision grinding machine, in which the main drive is directly from the motor to the grinding machine spindle and a small auxiliary drive is shown from a small sprocket mounted on the main motor pinion, and delivering power to a transmission case in the rear of the machine. Another example is shown in Fig. 3 which shows how the small chain drive is used to transmit power from the horizontal shaft to a universal joint shaft several inches higher in the machine, without the use of idler gears.

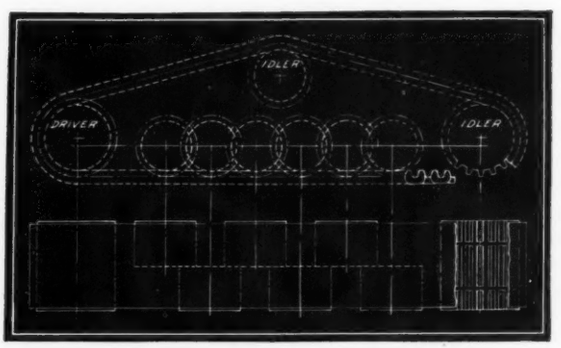


Fig. 6—Another special application, in which is used double width chain

Silent Chain Used for Spindle Drive

Another interesting application of a silent chain is to drive the spindles of a multiple drilling machine. In this case the axes of the sprockets are vertical instead of horizontal, and the chain is provided with outside guides instead of a central guide, in order to keep it from dropping off the sprockets. The sprockets are staggered to allow for greater adjustment of the spindles, and the width of the chain is doubled in order to engage both the upper and lower sprockets as shown in Fig. 5. In this case, the driving part of the chain becomes virtually a traveling rack, and in order to get proper action, the teeth of the sprockets are of involute form instead of the usual straight-sided tooth. It will be noted that an idler sprocket is placed on the inside of the slack side of the chain to keep it taut.

Fig. 6 shows an illustration of a special application of a chain drive to the rollers of a

wire straightening machine. This requires a special chain of duplex type which is made with teeth on both sides which bend in either direction.

When it is desired to mount one of the sprockets on a movable member in a machine, resulting in a changing center distance, it is necessary to make some provision for taking up the slack in the chain. There are several ways to accomplish this. One is to place an idler sprocket on the inside of the slack side of the chain, this idler being attached to either a spring or plate counter balance, or to a manual adjustment. Another way, and the one preferred in the case of Morse chain, is to place a shoe on the back of the slack side of the chain as shown in Fig. 4. This shoe should be convex and usually is made from cast iron. Many of these auxiliary applications doubtless will suggest themselves to the mind of the machine designer.

Standards for Machine Pins Are Proposed

A PROPOSED American standard, in tentative form, for machine pins of taper and cylindrical designs, has been developed recently by the sectional committee on machine pins and now is being distributed for criticism and comment. The sectional committee comprises members of the American Society of Mechanical Engineers and the Society of Automotive Engineers, organized under the procedure of the American Standards association.

An outline of the new standards follows. Criticisms will be welcomed and should be mailed to C. B. LePage, assistant secretary, American Society of Mechanical Engineers, 29 West Thirty-ninth street, New York, from whom complete drafts of the standards are available if desired.

The first objection to the present series is the arbitrary numerical symbolization which has no direct mathematical relation to the actual size of the pin. A second is the irregular progression from one size of pin to another. A third is the use of the large diameter as a basis for size designation, while a fourth objectionable feature, though a minor one, is the design of the ends, which are crowned in such a way as to leave sharp edges at both ends. And still another bad feature, though not dealing with the pins directly, is the lack of coherent relationship between the pins and reamers.

These objections are clearly too serious to be left unattended when considering the existing series as a possibility for an American standard. Certain revisions now are being recommended which would provide distinct advantages over present practice.

The first of the above objections can be eliminated by designating the sizes with fractional dimensions, which scheme would be a direct measure of the size of the pin. Varying the sizes in commonly accepted increments such as thirty-seconds, sixteenths, eighths and quarters would overcome the second, and both complications of the third can be minimized by adopting the small end of the pins as a basis for size determination. Such a scheme would permit the most economical use of one size of drill for all lengths of pins of a given nominal diameter.

Improvements in detail would minimize the fourth objection. If the small ends were rounded, the pins could be driven easier and the possi-

(*Concluded on Page 72*)

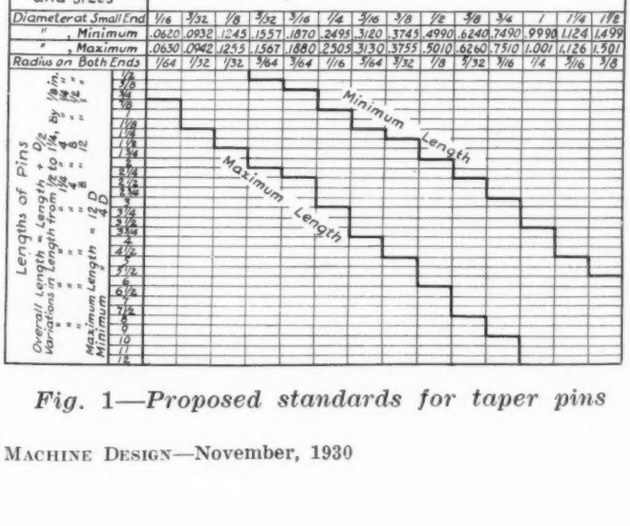


Fig. 1—Proposed standards for taper pins

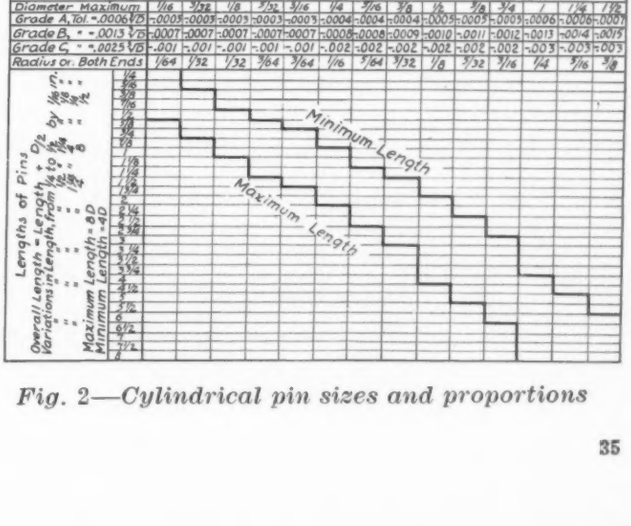
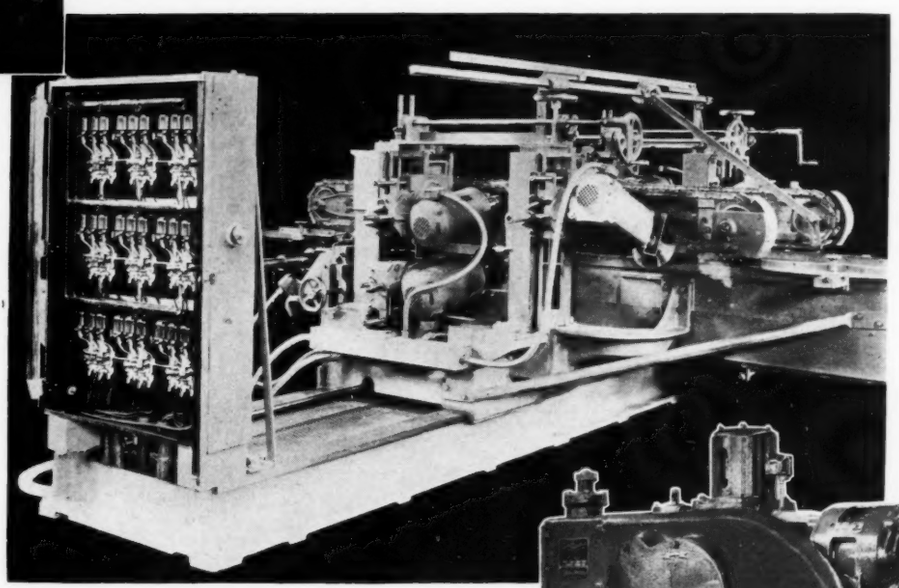


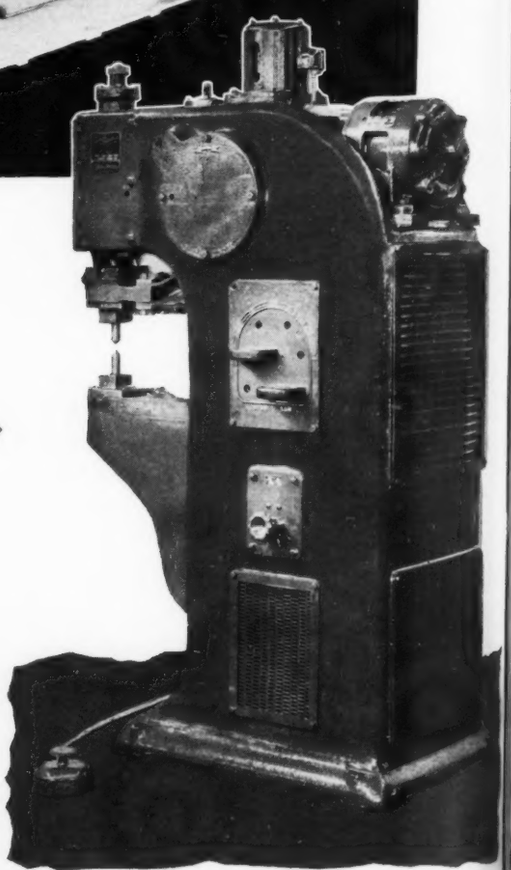
Fig. 2—Cylindrical pin sizes and proportions

Special Motor Requirement

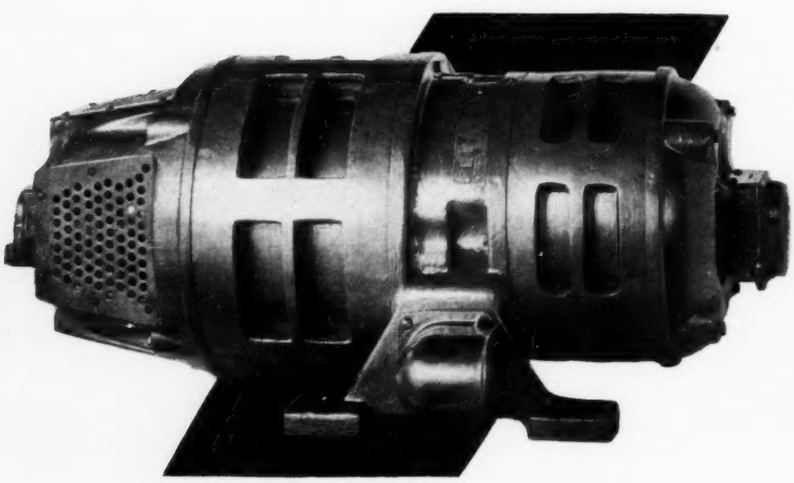
NUMEROUS motors and motor applications of special character are illustrated on the accompanying pages, laying emphasis on important developments constantly taking place in this field. At the left is shown an inclosed ventilated motor as used on the tenoner below. The cutters are mounted on motor spindles



SEVEN motors are employed on the double end tenoner illustrated alongside, which has been introduced recently. All arbor motors are of the totally enclosed type shown above, whereas the motors used on former machines were semi-enclosed only. The use of the fan-cooled motor eliminates any possibility of trouble due to sawdust and chips getting into the interior of the motors and causing damage to the windings



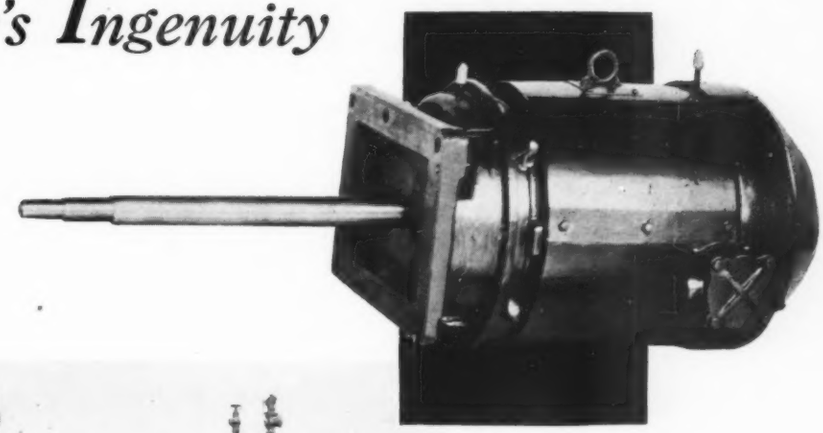
AN APPLICATION of a multispeed motor to an automatic spot or projection welder is illustrated at the right. Employment of this type of motor makes possible instant changes in operating speed and rate of production. The drum controller for changing motor speeds is mounted in machine frame as shown. On this particular application the motor is rated 2 horsepower, constant torque, at 1800, 1200, 900 and 600 revolutions per minute. In many instances the design of drive is simplified considerably by using multispeed motors



NEW design of two-bearing motor driven frequency converter is shown at left. This particular unit is rated 7½ kilowatts with 10 horsepower motor, 1800 revolutions per minute

Tax the Designer's Ingenuity

AT THE right is shown a totally enclosed, fan-cooled, squirrel cage motor with special back bearing bracket and shaft extension for mounting directly on a drilling machine. This particular motor is rated 10 horsepower, 1750 revolutions per minute. Many variations in design, are possible



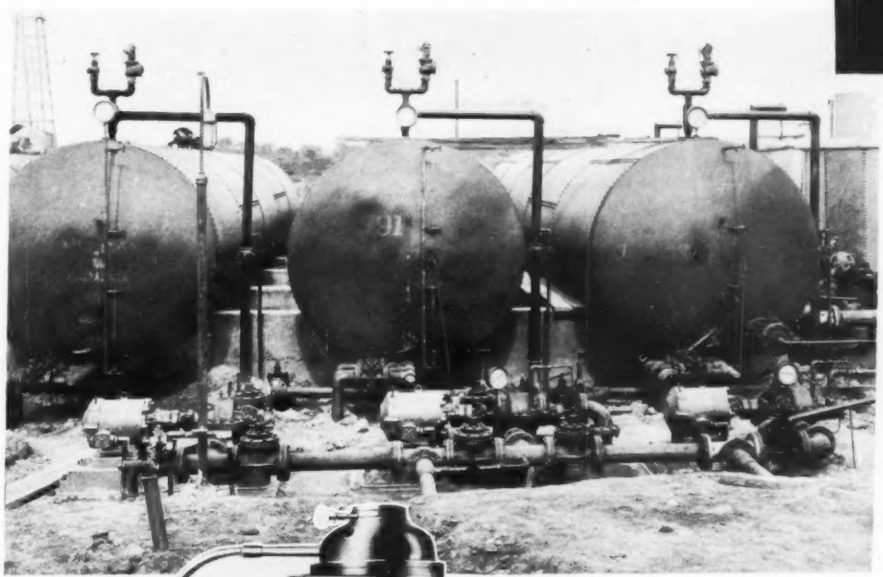
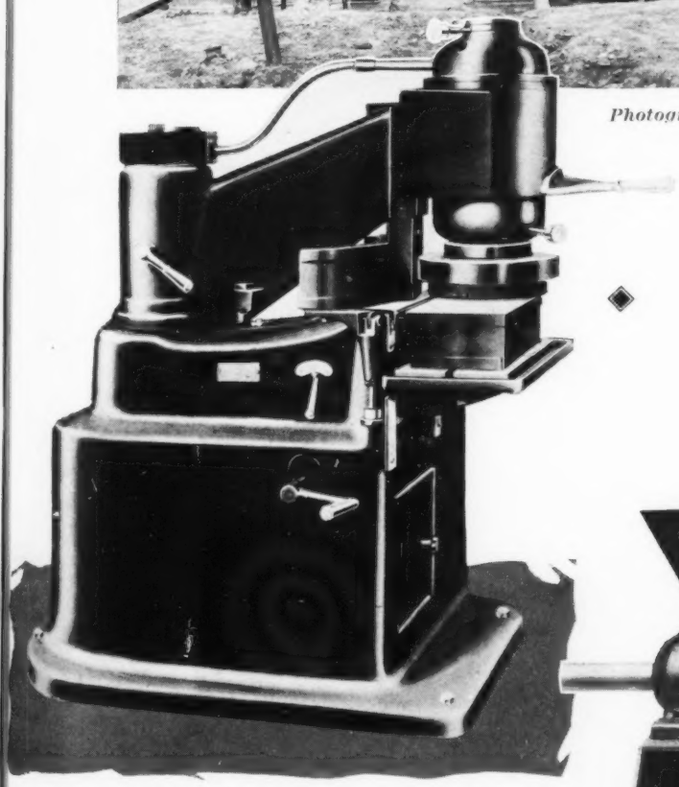
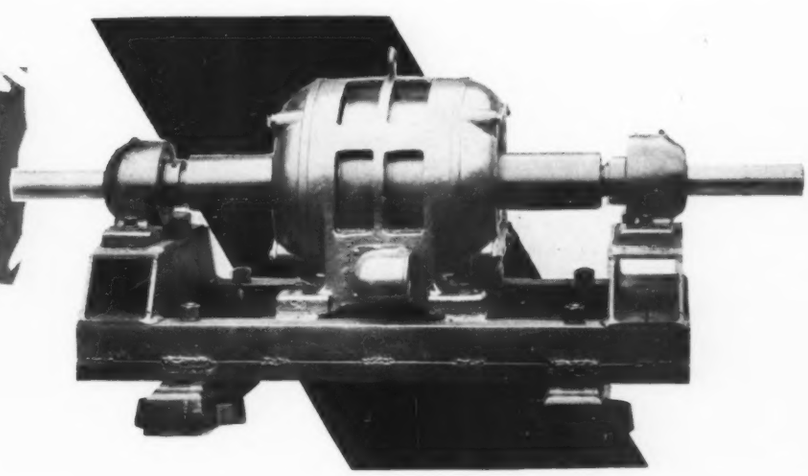


ILLUSTRATION at left shows an application of three 7½ horsepower, 1800 revolutions per minute motors which are used for driving pumps handling gasoline to storage tanks. Explosion-proof, alternating current, squirrel cage type motors are employed. The application is unusual in that severe conditions of exposure are encountered. No housings are required however for protection from the elements

Photographs, courtesy Louis Allis Co.



A SURFACE grinder driven by a drawn shell type shaftless motor is illustrated at left. The motor is mounted in the machine builder's housing as shown, and bearing bracket, shaft and bearings also are furnished by the maker of machine. This type has certain advantages over a standard motor in that several ratings can be provided in a single stator diameter with a change only in the length of the core



BECAUSE a double belt drive, with pulley centers a considerable distance apart, was required, the bearings of a standard motor were replaced by pillow blocks as shown at right

Concluding Section of a Three-Article Series

Fig. 1—Rough turned forged eccentric shaft

Photograph, courtesy Heppenstall Co., Pittsburgh

Steel Forgings in Design

By Lawford H. Fry

IT IS desirable after forgings have been heat treated to apply some form of test to ascertain that the treatment has been successful in developing the properties desired. A tensile test usually is used for this purpose. The standard test specimen of the American Society for Testing Materials has a gage length of two inches with a diameter of 0.505-inch giving a cross sectional area of 0.20 square inches.

For the general run of forgings one tension test will be taken from each treatment lot. The test specimen will be taken with its axis parallel to the longitudinal axis of the forging and will be located half way between the center and the outside surface in solid forgings and half way between the inner surface of the bore and the outside surface in bored forgings. To provide metal for test full sized prolongations should be left on a certain percentage of the forgings, or in the case of large shafts or axles the specimen may be taken from the end of a forging by means of a core drill taking out a bar three-quarters inch in diameter by four inches long.

One Test Usually Sufficient

While one test for each treatment lot will be sufficient for the usual run of forgings, it may be desirable for forgings of special grade to take one or more tests from each forging to make sure that every forging has been treated properly and has the desired properties. In the case of hollow forgings to withstand hoop stresses the tension test may be taken tangentially so as to measure the properties of the steel in the direction of the major stress.

It is usual in making tensile tests of forgings in accordance with the A. S. T. M. methods to measure four properties, yield point, tensile strength, elongation in two inches, reduction of area, and to use the values found and the relation between these values as a basis for judging the quality of the forging. It should be mentioned in passing that the yield point is measured by the drop of the beam of the testing machine for annealed or normalized forgings, while for quenched forgings an extensometer is used and the so-called "elastic limit" is determined. In reality the extensometer method is merely a refined method of determining the yield point and therefore "yield point" is used as a general term in the following discussion.

Relation of Physical Properties

For a given grade of forgings there should be a definite and balanced relation between the values found for the four properties mentioned. For example normalized and tempered carbon steel forgings of about ten inches in diameter should have a tensile strength of approximately 85,000 pounds per square inch, with a yield point of about 53 per cent of the tensile strength. The ductility of the forgings is measured by the elongation and reduction of area, and depends also on the tensile strength, but in an inverse ratio. If for example the tempering temperature were raised the result would be to reduce the tensile strength. The ductility should increase correspondingly. For the forgings indicated in the foregoing appropriate values for the elongation and reduction would be found by dividing the value of the tensile strength into 2,100,000 for the elongation and into 3,300,000 for the reduc-

CONCLUDING his series of informative articles on the employment of forgings in design Mr. Fry discusses physical properties of steel forgings and presents also some valuable data on the characteristics of a number of the alloys more commonly used in the design and production of forged parts.

tion of area.

For other types of steels the proper relation between the values for the four tensile properties will be somewhat different. With quenched and tempered carbon or alloy steels the yield point should be a higher percentage of the tensile strength. The same is true of normalized nickel or manganese steel. In the quenched steels and also with the normalized alloy steels the ductility has less tendency to vary inversely with the tensile strength and usually fixed minimum values for elongation and reduction of area can be set for each grade of steel and each size of forging. It also may be noted that compared with the normalized steels the quenched and tempered steels have relatively low values for the elongation and much higher values for the reduction of area.

It is impossible within the scope of the present article to give representative values for the tensile properties of all the steel forgings that may be used in machine parts. Not only are there a large number of various alloy steels of varying compositions, but the properties vary with the dimensions of the forging and with the details of the heat treatment selected. Information as to the properties to be expected from various steels in small sizes is given in the S. A. E. handbook, while properties for some alloys in the larger sizes are given in the A. S. T. M. specifications for carbon and alloy steel forgings. Representative compositions and tensile properties for various types of steel used for forgings are given in Tables 1 and 2 in the second article of this series which appeared in the October issue.

From what has been said regarding the relation between the values of the tensile properties, it will be understood that the proper specifications for a given grade of steel cannot be prepared by combining values of the tensile properties at haphazard. There must be a proper balance between the values, and any change in an established specification should be made only after careful study of the metallurgical and manufacturing conditions. To take a satisfactory specification and raise the ductility values by a couple of percentage points will not necessarily ensure a supply of better grade forgings. The effect may be merely to force the manufacturer to re-treat a number of satisfactory forgings and thus increase the cost without any commensurable gain in value to the eventual user.

Tension Tests May Be Inadequate

In the present state of our knowledge tension tests of small sized specimens do not direct information as to the class of service for which a given steel is best adapted. The tensile strength and yield point give information regarding loads which can be carried in direct tension, and recent research on fatigue has shown that in the case of a small specimen rotating as a loaded cantilever the fatigue strength is closely proportional to the tensile strength. The fatigue strength is the maximum stress under which the specimen can rotate indefinitely without failure, and between forty and fifty per cent of the tensile strength, the exact figure depending on the type of steel and the kind of heat treatment. There is some practical evidence to be found in locomotive service supporting the view that high fatigue strength is to be expected when the tensile strength is high.

Little direct connection can be found between the ductility values and the service value of the various steels. The elongation measures the amount of permanent stretch which the steel takes while being loaded from the yield point to the breaking point, and the reduction of area is produced under the same range of load. Consequently both values come into being only when the steel is stressed beyond the loads to which it will be subjected in normal service. The chief reason for making a determination of the ductility values is that they give a check on the grain refinement produced by the heat treatment so that though the ductility values do not appear directly to measure qualities which are utilized in normal service they are valuable in acceptance tests as they assist in determining whether the steel is of proper quality and properly and uniformly heat treated. Though the steel does not utilize the ductility in service yet

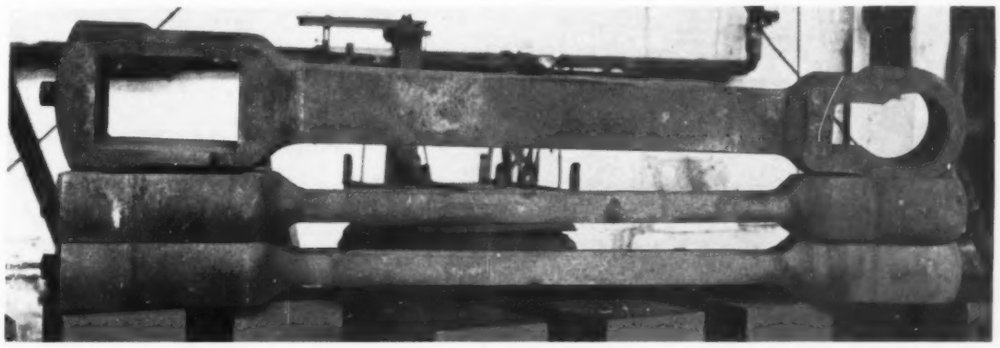


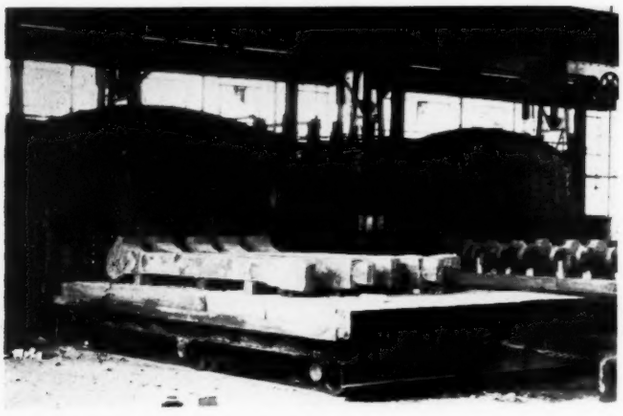
Fig. 2—Forged connecting rods, rough turned, for use in diesel engines

Photograph, courtesy Heppenstall Co., Pittsburgh

a steel which had less than the ductility proper to it might be in poor condition to give good service.

The question of utilizing laboratory tests to determine the relative merits of various steels still is under study. It formed the subject of a paper presented by Bradley Stoughton to the American Society of Testing Materials in June. This offered a number of tensions and impact test results and attempted to establish a rational basis of comparison for the various types of alloy steels.

Brief reference has been made to the general characteristics of the alloys most frequently used in steel forgings. The following more detailed account acknowledges assistance from Charles McKnight's paper on *Alloy Steels in the Railroad Field* presented to the Southern and Southwestern Railway Club, March, 1930.



Photograph, courtesy American Locomotive Co., New York

Fig. 3—Annealing furnace receiving batch of connecting rod forgings

Manganese. This element is a necessary ingredient in the manufacture of steel. It is added to the molten steel and assists in removing deleterious oxides which would be injurious to the steel. A sound carbon steel will contain from 0.50 to 0.80 per cent of manganese and in this range the manganese is not looked on as an alloy. With from 1.0 to 2.0 per cent of manganese the steel will rate as an "intermediate manganese" steel. The manganese will add strength without decreasing ductility. This steel is used with some success in the normalized condition in some forgings of small diameter such as automobile rear axles. In the quenched and tempered condition it gives satisfactory results for armature and other shafts up to about six inches in diameter. In larger sized forgings used in the normalized condition the intermediate manganese steel is somewhat erratic under heat and requires special care in forging. The value of manganese as an alloy is increased by combining with it another element such as vanadium or nickel. With either of these elements supporting the manganese very satisfactory normalized and tempered forgings up to twelve inches in diameter can be produced. Such forgings are used in considerable numbers for locomotive driving axles, crank pins, connecting rods, etc.

Silicon. This like manganese is an excellent deoxidizer and is used in connection with manganese to remove deleterious oxides from molten steel during the process of manufacture. The residual silicon remaining in forging steel after deoxidization is complete usually will be from 0.15 to 0.35 per cent. Silicon is not used as an alloy in forging steels. It is used in some spring steel in a range of from one to two per cent and also is used in steel for parts for electric transformers in the range from three to five per cent.

Molybdenum. This element is used as an alloy in amounts up to about 0.50 per cent, usually in combination with another alloy such as chromium or nickel. It increases the effect of heat treatment and increases strength and hardness. Its action is due to its formation of carbides.

Nickel. This element is probably the most widely used alloy. It possesses an affinity for iron and adds strength and toughness by its action on the ferrite. It does not form carbides. Forging steels may have a nickel content of from one-half to five per cent either alone or in combination with chromium, or molybdenum, or both according to the properties desired. Nickel steel forgings are used widely for large parts of heavy machinery where strength and toughness are required. McKnight points out that large die blocks for drop forgings are made almost without exception from a nickel bearing steel.

Alloys Outside Forging Range

It may be mentioned here as a matter of interest that the alloys of nickel and iron which lie outside the range of the forging steels possess many varied and valuable properties. Invar, consisting of approximately 35 per cent of nickel and 65 per cent of iron, is used for steel tapes and many other purposes because its thermal expansion co-efficient at ordinary temperatures is practically zero. The stainless steels or more properly, stainless iron, which is finding such varied uses, and which is particularly valuable for many applications because of its strength at high temperature, contains approximately 18 per cent of chromium, 8 per cent of nickel and the remainder iron with practically no carbon.

Chromium. This element may be used in forging steels in the range from one-half per cent to two per cent. It adds strength and hardness by the formation of carbides. In forgings it generally is used in combination with nickel or vanadium. It gives its best results in material which is to be quenched. Its use in connection

(*Concluded on Page* 47)

Effecting Economies in Finishes

By Wm. J. Miskella, M. E.
Consulting Engineer, Chicago

SINCE it is the history of design and development to omit, during dull periods, all unnecessary embellishments, it likewise is true that any further reductions in costs are looked upon with favor by both producers and buyers.

One of the most effective ways to cut finishing costs is to make a radical change in the nature of the finish. This is much better than reducing the number of costs or spending less money for labor in sanding, polishing or other smoothing technique.

Considering for a moment the surface of a rough casting, there are two obvious ways to smooth the ultimate surface; one, to grind the casting to a plane surface by removing the high spots and rough ridges; the other, to apply a surfacer which in itself has the dual property of adhering to the metal and adaptability to easy sanding. Labor, time and expense involved

Fig. 1—(Above)—Filler before sanding. Fig. 2—(Below)—Filler after sanding operation

in the grinding method naturally suggests a combination of cost factors which are not attractive. The surfacing method has greater possibilities and has in its favor many years of practical use.

The evolution of this detail of finishing has established as fairly standard the use of a modern tenacious surfacer or filler which becomes

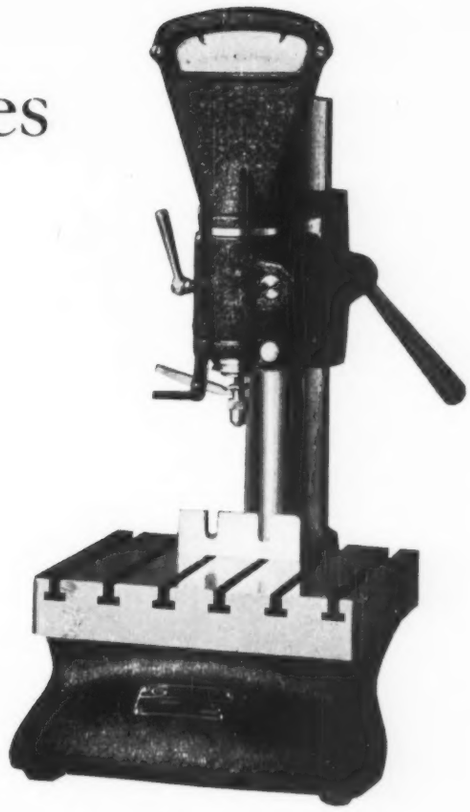


Fig. 3—Measuring machine showing attractive crystal finish

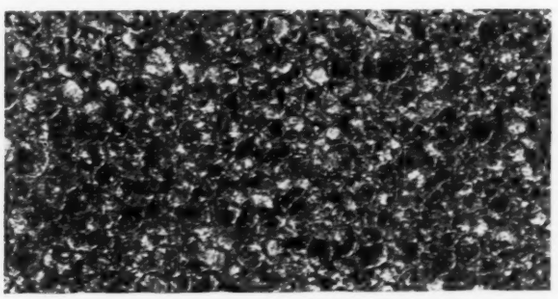
so hard that it requires the highly resistant-to-wear property of waterproof sandpaper to reduce its even rougher surface to a comparatively smooth one. This is shown graphically in the two cross sections, Figs. 1 and 2. The first illustration indicates the appearance of the filler before sanding and the second shows how the surface appears after the high spots of the filler have been reduced.

Wouldn't it be fine if all the work of applying the filler and hand-sanding before subsequent coats of the finishing material can be applied could be eliminated? That is what actually may be accomplished by using baked specialty finishes, the outstanding example of which is crystal japan, as illustrated by Fig. 4. This material is available in a limited number of colors, but black is the most popular. Dull black perhaps would be a better name, since a gloss effect cannot effectively be obtained with this particular finish.

Crystal japan has the peculiar property of making the surface of a machine finished with it appear smooth, when as a matter of fact it is rough. The effect created by the varying and alternating dull and shiny spots which are characteristic of the finish is not the chief reason for its popularity; it is principally because no filling or surfacing operations are required.

Thus, the modus operandi is to apply the material directly to a rough surface after which the finished article has a smooth appearance, without any preparatory steps aside from that of rubbing off the more pronounced high spots. It is not necessary to eliminate all the imperfections in the metal, or on the surface. Because of this and its remarkable "masking" properties a single coat will give satisfactory results.

There are many interesting features which make this crystal finish attractive to machine design. It is easy to apply, is durable and has a good appearance. The finish is a raised textured one, not smooth, this being the reason the surface of the machine needs no special preparation except that it be free from dirt and grease.



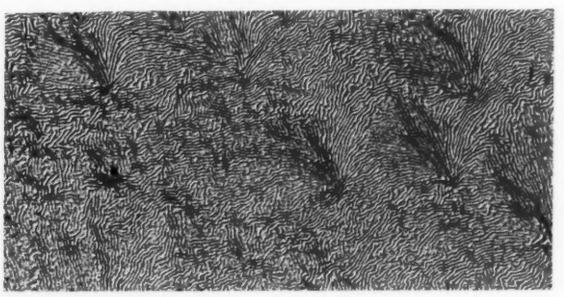


Fig. 4—(Above)—Sample of crystal japan finish which is easy to apply and has lasting properties. Fig. 5—(Right) This crinkle japan surface is produced by applying special material and using heated oven

Fig. 6—(Above)—A particularly attractive finish termed crinkle and sag japan, effected by applying excess material while surface is in horizontal position. Raising surface to vertical will create design shown

Costs Cut by Changing Finish

This is a radical change in the finish as a means of cutting costs, rather than curtailing the amount of work ordinarily necessary to obtain a smooth gloss finish. Assuming the former finish were smooth and glossy the radical change suggested at the beginning of this article would be the dull appearance of the crystal finish, as well as its novel and also attractive design.

There is another interesting design feature peculiar to baked specialty finishes which the reader should know. That is the ease of obtaining and controlling the size of the crystals which are formed. One may have a fine-mesh crystal for small machines, or surfaces, or large-mesh crystals for large machines. Should the machine be so designed, or of such a shape as to permit it, a combination of the two sizes may be used. The finer mesh crystals would be appropriate for the upper or small part and the large mesh crystals for the lower or flaring part.

Thick Coat Makes Large Crystals

This is possible because the application of a thin coat of the material produces small crystals while the application of a thick coat produces large ones. Any apparent failure of the finish to level out smoothly soon is rectified in the oven. The surface flows together as soon as the heat strikes it.

It should be known that the crystals form only in the darkness of the oven so should not be allowed to air-dry for any length of time before being placed in the oven. And they form only when subjected to the chemical effect of the incomplete combustion of the open-flame gas burners—or in "foul air." After the formation of the crystals the machine parts may be subjected to a high bake and may be handled just as any baked japan finish is handled. This means that it would be necessary for the machine shop to be equipped with baking facilities and spraying equipment, as this finish while it can be applied by dipping, is much better sprayed.

It is no longer considered waste of time to finish a machine in a becoming color. So these crystal finishes are being produced in various shades of green, maroon and a few other colors besides the dull black. With these a number of exclusive and characteristic color shades may be made by intermixing any of them. However, should some customer desire a particular color on his machine, it would not be possible to *tint* the material itself with colors, since the limited

number of color pigments that are suitable must be incorporated when the material is being manufactured.

To meet certain conditions, the crystal material also is available in clear or transparent form which makes it possible first to apply a rough colored base coat on the surface of the article and then apply a second coat of the transparent crystal japan. Thus almost any color effect desired is obtainable, providing there is no objection to the additional cost of the colored base.

Color of Base Coat Is Changed

The designer should bear in mind the fact that the application of the transparent coat will change the apparent color of the base coat. This is due to the yellow tinge of the transparent material. It is well in this connection to call attention to the tendency of colors to darken under heat. Thus the base coat would change in color were it subjected to the baking operation necessary to harden the crystal finish. However, if the hardening feature is not important, inexpensive equipment can be improvised to do the work in any color. As stated before practically all of these specialty materials are applied by spraying, as illustrated in Fig. 4. Most of the machines are finished in this way—meat slicing machines, scales, and even large machines for production plants.

An effective imitation leather effect may be obtained by using the crystal material to form the design and then applying a gloss coat on top to kill the alternate gloss and shiny specks in the first coat. Such a finish is just as durable as ordinary gloss japan. It also can be produced in either small or large mesh design to harmonize or co-ordinate with the article being finished.

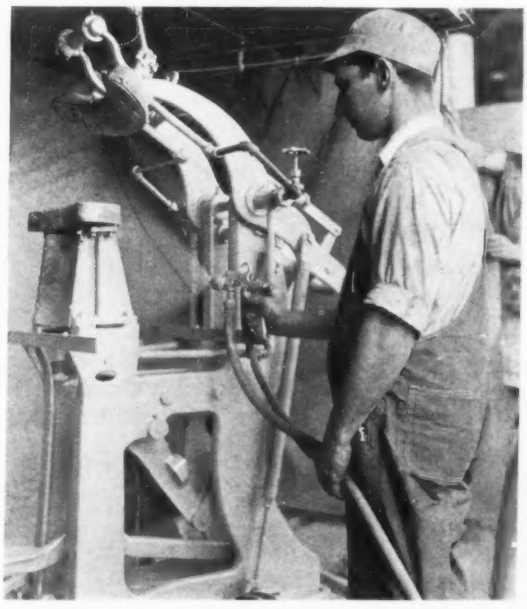


Fig. 7—Applying finishes by spraying

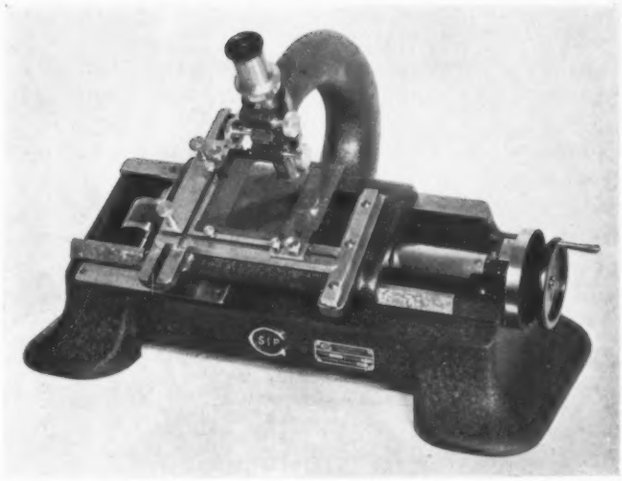


Fig. 8—Spectographic plate measuring machine on which crystal finish is used

The crystal has another virtue. It may be manipulated to work on wooden as well as metal parts. A machine having a combination of construction materials may be finished uniformly providing the time and trouble to do some experimenting, in advance, is taken to assure the ultimate result.

Crinkle japan is still another finishing material which possesses many of the properties of crystal japan. It is illustrated in Fig. 5. A special material is required to produce it. A baking oven from which the "foul air" required in manipulating the crystal japan is excluded is absolutely necessary. The machines are placed in the hot atmosphere of a heated oven while machines finished with the crystal japan must first be placed in an oven, the interior temperature of which does not exceed that of the room.

Decorative Design Produced by Flooding

Some clever and interesting variations of this crinkle finish may be obtained by flooding, or applying excess material while the surface is in a horizontal position. By raising the machine to a vertical position the flooded spot will sag and create a decorative design as shown in Fig. 6. This is an especially pleasing finish, and should be mentioned for the sake of the designer who may form a dislike for the finish because the ultimate appearance is produced by purposely creating what he ordinarily looks upon as a serious finishing blunder. He should appreciate the fact that the buyer seldom knows how the effect is produced and therefore is mystified. This will add considerably to baked specialty finishes. The finish has been used for some time on high class articles such as radios, cameras and various others.

The plain crinkle may be embellished with

decorative touches by wiping a thin coating of gold bronze to disclose the blue background of the basic crinkle finish underneath, thereby producing an irridescent, two-tone effect in blue and gold. These decorative touches may be applied to the more commonly known crystal finish also.

When a customer has a number of machines to be finished and it is desired to specify baked novelty finishes, it always is best to have a sample which has been agreed upon. Once the standard has been established it is possible for the finishing department to fulfill all future orders according to the sample which has been selected.

It will be seen that there is a world of low-priced decorative effects to be obtained by taking advantage of the deceptive advantages of baked specialty backgrounds. And these may be varied still more with air-dry touches of lacquer base finishing materials to produce a desired effect.

Cost Factor To Be Considered in Welding

By Robert E. Kinkead

WELDING is finding increased application in machine design but it often is the case that economic value is not studied. In the accompanying abstract of a paper presented recently by Robert E. Kinkead before the American Welding society, the cost element is discussed from this point of view.

SERIOUS consideration is being given by manufacturers at the present time, to the matter of welding costs. The reasons for the interest in this subject are not difficult to find. Use of welding is spreading rapidly; perhaps more rapidly than at any time in the past 15 years. Welding holds out a promise of important cost reductions. The matter of welding costs would be comparatively simple if we had to deal with only one process. As a matter of fact, there are ten well defined welding processes which are different from each other in the matter of use in production and which produce widely different results in the physical behavior of the welded product itself. The situation is still further complicated by claims of vendors of equipment and supplies.

Many of industrial machinery and parts are selling in a sharply competitive market with a fallacious cost indicator as reference point. We personally are aware of a number of competitive products in which the service life in one case is ten times the service life of the product in another case, yet the manufacturer of the equipment which has the longest service life is basing his selling price on labor, material and overhead and comparing it with a similar figure which he estimates his competitor is able to reach. As a matter of fact the man with the long life equipment is giving his customer something that has an economic value of the order of 10 times the economic value of the product of his competitor. Under these conditions the manufacturer who has put economic value into his product probably has no one to blame but himself if he cannot earn profits.

The question naturally arises as to how economic value can be established. Experience has shown that it is not as difficult as it appears at the outset to establish the economic value of a product. Leaders in industry have been doing that very thing in recent years. The product is tested under the direction of scientifically trained observers under service conditions or a close approximation of service conditions. The physical laboratory is no longer a luxury in industry.

In the welding field we are becoming convinced that the mere fact that a weld may be produced which is stronger than the parts joined is not significant. We are becoming increasingly aware of the fact that resistance to tension loading is only one service requirement to be met in the case of welded joints. Resistance to corrosion, to fatigue, to high temperatures, and the other service requirements are as important, and in many cases more important, than resistance to tension loading. The service behavior of welded structures or products with reference to these conditions determines the economic value of the welded product.

Prof. Moore who is on the staff of the University of Illinois ran some life tests on pressure vessels, for instance, in which he showed that the life of a pressure vessel welded in a certain way was of the order of 400,000 cycles of service loading but the same vessel welded in another way had a life of the order of 5000 cycles. It seems to us that Prof. Moore's work established the relative economic value of the product when welded by the two different methods. It is quite probable that the buyer would be willing to pay considerably more for a vessel which would stand 400,000 cycles than he would for one which would stand only 5000 cycles. What is true of pressure vessels, such as Prof. Moore investigated, is also true of welded buildings, machine parts and industrial equipment.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments from Our Readers. Machine Design Will Pay for Letters Suitable for Publication

Directory Is Outstanding Feature

To the Editor:

MAY I register my enthusiasm concerning your directory of alloys. I believe this is one of the most outstanding practical contributions any technical publication has offered its readers. Trade names no longer are formidable barriers to the designer who wants to know something quickly about a hitherto unknown material. The directory not only gives the source of more specific information, but it also gives enough summarized information to indicate whether further investigation is desirable.

In maintaining operating equipment which springs from many sources and employs many materials, such as aircraft, quick repairs often are essential to successful operation. If only an unstocked trade named material is known as the original specification for a part, costly delay may result in its procurement. This now may be avoided by the directory, used either as a source indicator or for the discovery that another material, available in stores, is similar or equivalent and safely may be used as an immediate substitute.

Perhaps all the information is known to the specialist in metallurgy, but to the general designer it is a distinct boon. The specialized uses given will correct many an ill-founded enthusiasm for a new material as being suitable for almost any purpose.

—JOHN F. HARDECKER,
Philadelphia

Itemized Index Is Useful

To the Editor:

AGAIN I must compliment you on your magazine. There have been times when I have wondered whether you would be able to live up to the high standard you set in the first issues, but apparently you are not only living up to standard, but passing it.

Your latest innovation, the new itemized index, I believe will be of great value. Bringing advertising and editorial matter together in a single list undoubtedly will save time for many readers.

May I suggest, however, this further improvement: that you add, under each editorial item the name of the author, and the name, issue and page number of the magazine, so that the index can be cut up and each item pasted on a file card without pen work. At least with my filing system this would be very helpful, though my methods may not be representative of a large portion of your subscribers.

—JOHN FLODIN,
Minneapolis

Calculating Moment of Inertia

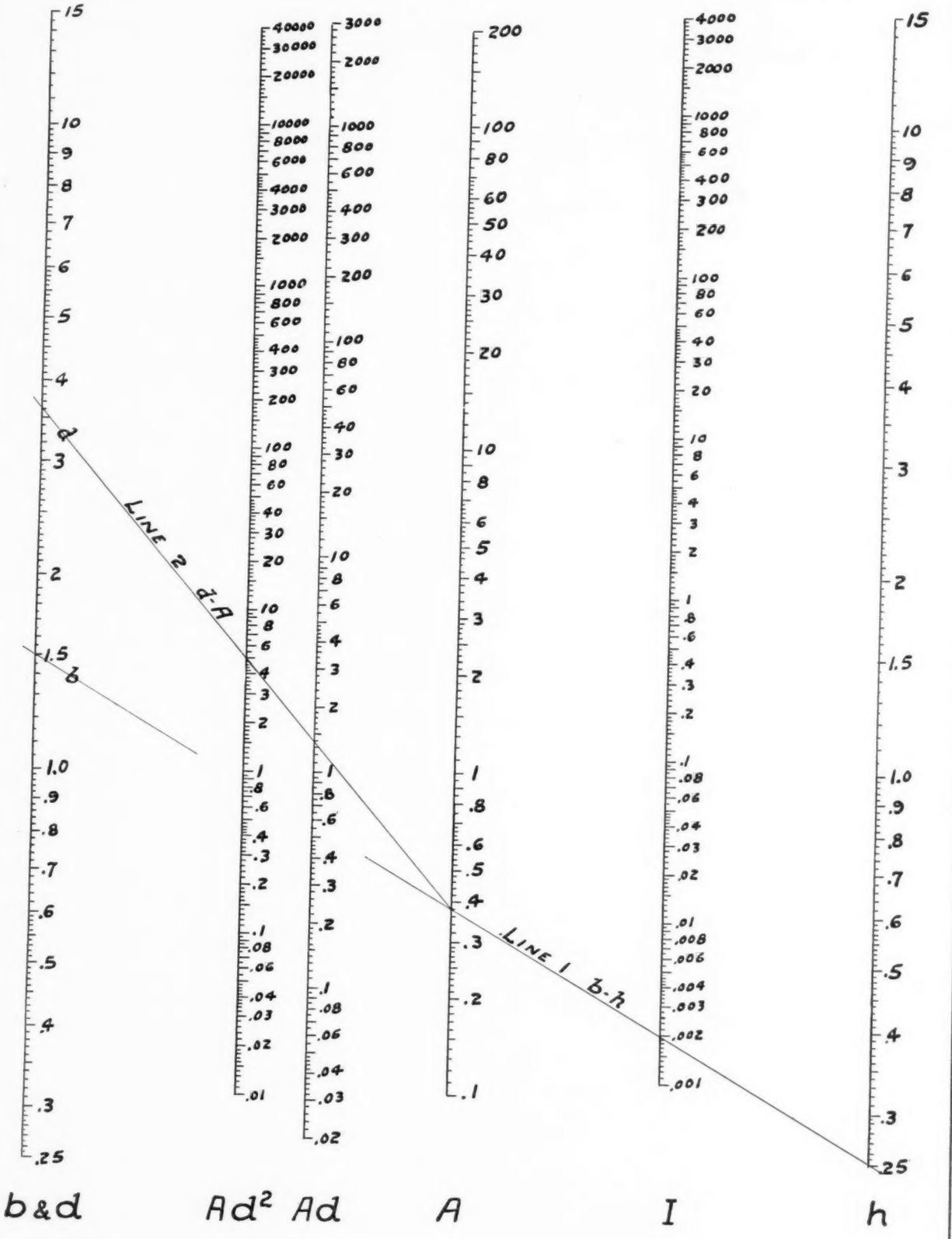
To the Editor:

A MATHEMATICAL process which the designer never allows to cool is the computation for moments of inertia, section modulus, and centers of gravity. For this reason I believe that this late supplement to the discussion begun by Mr. Flodin in the March issue and added to by Mr. Bennett in the June number, is still in order.

My contribution is the accompanying chart (on the following page) which simplifies the mathematical processes considerably, and the boxed table for standardizing the tabular method. Our own means for avoiding the labor of reproducing this box is in using a rubber stamp on which there are spaces for six components. The addition of "Dimensions" to the table enables the further application to machine parts or odd shaped castings which usually can be divided into a number of rectangular components.

The terms used are the same as Mr. Flodin's. The additional formulas required to

Chart for Determining Center of Gravity, Moment of Inertia & Section Modulus of Unsymmetrical Sections.



transfer the axis of the whole section from *a-a* to its center of gravity, X-X, to compute the moment of inertia about the X-X axis, and to find the section modulus of the whole are given below the table in the order of their use. The subscripts (t) refer to totals at the foot of the table.

An example is given below to illustrate the use of the table.

Comp.	Dimensions			Cen. of Grav.		Mom. of Inertia		
	b	h	d	A	dA	$I + d^2A = I_a$		
1	1.50	.25	3.625	.375	1.359	.002	4.928	4.930
2	.25	1.75	2.625	.4375	1.148	.112	3.014	3.126
3	1.50	.25	1.625	.375	.609	.002	.990	.992
4	.50	1.50	.750	.750	.563	.141	.422	.563
Totals	.....			1.938	3.679	.257	9.354	9.611

$$x = \frac{dA_t}{A_t} = \frac{3.679}{1.938} = 1.898 \qquad x^2 = 3.602$$

$$I_x = (I_a)_t - (A_t x^2) = 9.611 - 8.98 = .63$$

$$Z = \frac{I_x}{y} = \frac{.63}{1.898} = .332 = \text{section modulus}$$

y = distance from X-X to the farthest outer fiber.

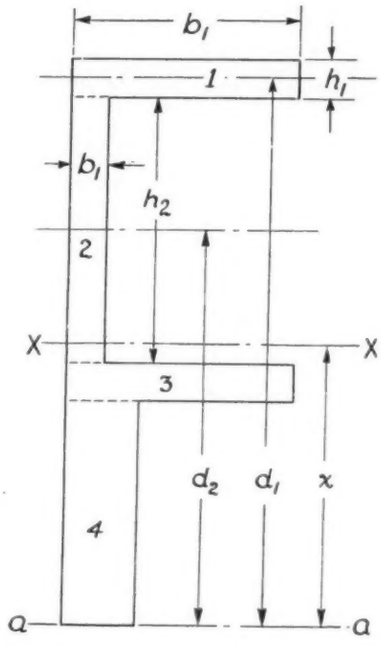


Diagram illustrating terms used in the foregoing expressions and table

Referring from the table to the chart for component number one, the values of the four computed quantities may be read from the four center scales at the intersections of lines one and two. While these scale values are not as accurate as the computed values of the table, they are close enough for practical purposes considering variations of the section itself. When using sections built up from standard channels, angles, etc., line number two only is used.

—M. G. Van Voorhis,
Cleveland

Itemized Index Is Useful

To the Editor:

IT HAS always been my belief that the advertising pages of a good technical journal are of as much value to the reader as the editorial pages. The itemized index appearing regularly on page 7 of Machine Design is a step in the right direction, since with it the contents of the entire magazine are presented to the reader at a glance.

—E. H. Hagen,
Appleton, Wis.

Steel Forgings in Design

(*Concluded from Page* 40)

with nickel for heat and corrosion resisting material has been noted.

Vanadium. This element has a most powerful effect on steel and in forging steels usually is not used in amounts exceeding 0.25 per cent. It is an excellent deoxidizer and as an alloy is of great influence in heat treatment in producing grain refinement. Vanadium has been responsible for the wide use by the railroads of large quantities of normalized and tempered carbon-vanadium forgings having a high tensile strength and high yield point. It acts by formation of carbides. In quantities up to two per cent it is used in high speed tool steels.

Conclusion. The information given in the present article is intended to supplement the practical experience of the designer of machine parts. It is not possible to draw up a schedule which will show automatically the best steel for any given forging. The attempt has been made to sketch the metallurgical background which influences the character and characteristics of steel forgings.

In conclusion attention is drawn to the fact that in the study of troubles, which is one of the necessary steps to progress, the forging must be considered mechanically as well as metallurgically. It is poor engineering to change to an expensive alloy steel in an attempt to correct troubles caused by sharp fillets or improper lubrication.

SIX-CYLINDER models led in the London motor show, these models numbering 300 out of the 506 exhibits. Of the others, 88 cars had 8 cylinders, 7 had 12 cylinders and 2 had 16 cylinders. There were also 8 two-cylinder cars.

Innovations include fluid flywheels, a self-changing gear box, a car with 6 speeds forward and 2 in reverse, and a 6-wheel car for estate work. British exhibitors lead with 31 builders and 292 models, French second with 18 builders and 81 models, United States third with 17 builders and 69 models.

Railroad Field Would Benefit By Redesign

ONE of the most interesting problems of modern civilization is that of transportation. The growth in use of automobiles and the advent of the airplane have served to carry public attention away from developments in the older and less spectacular modes of travel, namely railways and steamships.

Nevertheless, the world still depends upon these old, reliable agencies for an important share of its transportation requirements, and will continue to do so. Considering this fact, and also the tremendous capital tied up in these rail and water lines, it would seem that more thought should be given to their improvement.

In Germany a train driven by propellers similar to those on airplanes recently traveled 100 miles per hour in experimental runs. Whether or not the idea is practical remains to be seen, but it is evident that something should be done to increase the efficiency, speed and convenience of railway transportation.

In the United States we appear to be satisfied to ride in heavy trains at speeds easily equalled by light automobiles. Is there not an opportunity for design which will reduce the weight of rolling stock, increase the safe speed and add to the comforts of travel? With numerous choices of power available for propulsion, with lighter and stronger materials and with a greater demand for efficient transportation, it would seem that American ingenuity could devise something better than our cumbersome, 50-mile-an-hour railway transport.

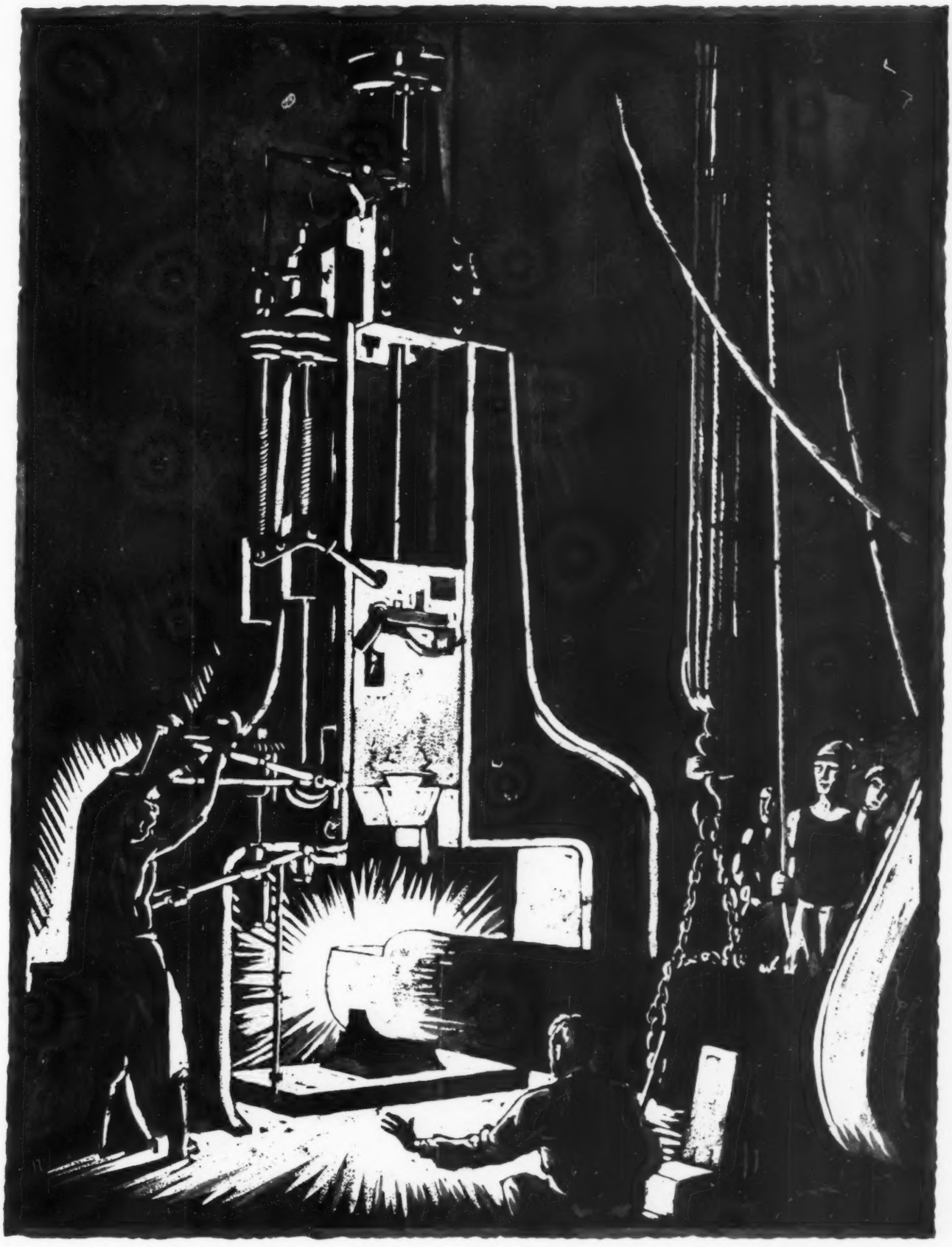
Here is a field in which the courage of railway officials, initiative of railway equipment manufacturers and resourcefulness of machine designers could be combined to advantage.

Design Is The Basic Fundamental

IT HAS been suggested that this is the production man's age; that in these times, due to the necessity for building cheaper machines, the production executive has it in his power to assist or retard to a hitherto unthought of extent the success of his company.

Undoubtedly this is correct, to a degree. But there are numerous other considerations which enter into the creation of a mechanism or machine—and by far the most important of these is the design. For without fundamentally good design it would be impossible to produce at reasonable cost the parts embodied in a complete machine.

So the honor is to the designer. The responsibility rests with him. And that this is becoming more and more apparent is borne out by speeches being made constantly by leading industrialists at association meetings, dedications and other functions, in which well deserved credit is accorded the design profession.



James Nasmyth and the Steam Hammer

Great Moments in Machine Design—Fifteenth of a series of original drawings prepared exclusively for this magazine symbolizing the designer's contributions to the progress of mankind

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

CENTRIFUGAL force is employed in the operation of an automatic shaft coupling designed by Paul J. Thomas, Narbonne, France, and recently granted United States patent No. 1,775,741. Through the use of this unit entrainment of a driven member is effected after a certain range of lost motion of the driving member. In the accompanying illustrations Fig. 1 shows a section of the unit and Fig. 2 the arrangement of gears within the casing.

When the driving shaft 1 is set in motion it carries with it sun gear 6 which in turn drives the entire coupling 3 by means of gears 55′, 78.... Driven shaft 2 offers a certain resistance, remaining at a standstill as driving shaft 1 begins rotation. Under the action of centrifugal force the shafts 22 tend to move

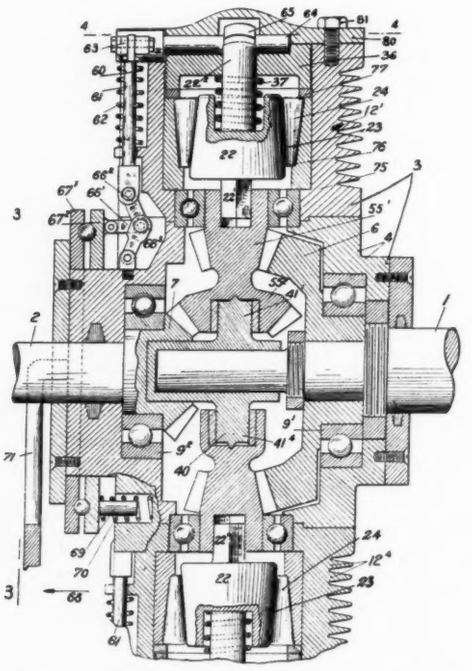


Fig. 1—Section of coupling which acts automatically under influence of centrifugal force

away from their planet gears while compressing their springs 37. When this force is sufficiently great to overcome the resistance of the springs, the shafts 22 become more and more progressively wedged by their conical portions 23 in the ring of conical rollers 24. Complete wedging of these members causes the rotation of the driven shaft 2 by the driving shaft 1. Shafts 22 being wedged, they oppose the rotation of their planet gears such that these latter, which

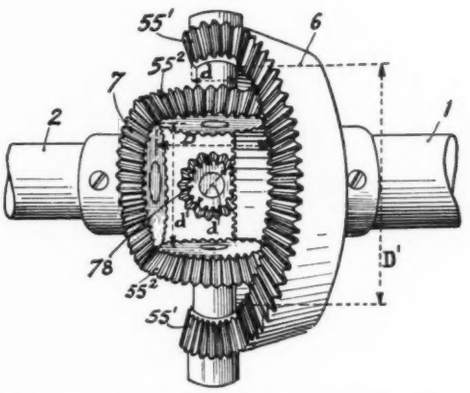


Fig. 2—View showing arrangement of gears within the casing of the coupling

are in engagement with the sun gears 6 and 7, form coupling members between the two sun gears.

When the speed of the driving shaft 1 decreases, springs 37 expand again and carry shafts 22 back toward their respective planet gears. These shafts 22 then release the rollers 24 and can turn freely with their planet gears which roll again on the sun gear 7 until the driving shaft stops.

A safety device is provided on the coupling to stop the driven shaft 2 without having to stop the driving shaft. The operation is accomplished by a fork 71. Normally the springs 70 thrust the pins 69 in the direction of the arrow 68; the links 66^1 drawn by the annulus 67^2 pull on the articulation of the links 66^2 and 66^3. These thrust the rods 61 in such a manner that the rods, having no action on shafts 22 of the planet gears, permit these latter to displace themselves freely and become wedged against rollers 24 Contrarily, if it is desirable to stop the driven shaft the clutch fork 71 is operated to thrust the outer annulus 67 in the inverse direction to 68. Under this action the actuating finger 65 is applied to the extremity of the shaft 22 of

the planet gears and disengages same from the rollers 24.

INVENTION of a starter by W. L. McGrath, introduces a unique system of transmitting power from a prime mover to the flywheel of an engine. Patent No. 1,775,823 recently was granted for this device and the Eclipse Machine Co., Elmira, N. Y., has been made the assignee. The accompanying illustrations show Fig. 1, a section of the unit with parts in normal disengaged position, and Fig. 2, a similar view with the parts in cranking position.

During the cycle of operation, plunger 25 having been depressed, the screw shaft and pinion are shifted inwardly by means of the linkage of 31 with 32. As the pinion comes into full mesh with the flywheel, the plunger and bell crank depress the switch button and start the electric motor, which in turn rotates the flywheel through the pinion on the end of its shaft.

When the engine starts and the plunger is released, demeshing of the pinion from the flywheel is facilitated automatically. This is accomplished by virtue of the threaded connection of the pinion with the screw shaft. If the

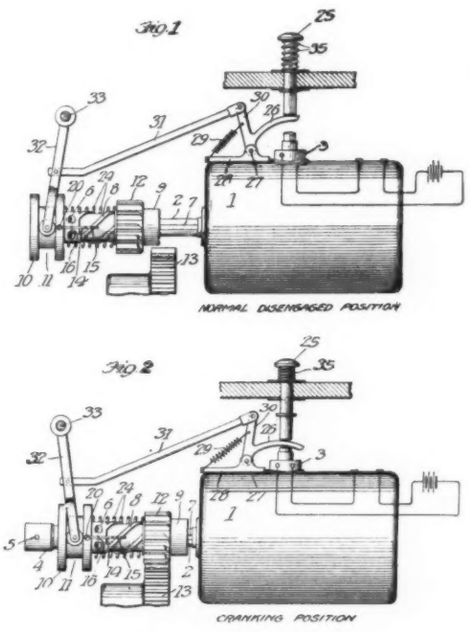


Fig. 1—Starter system, showing parts in disengaged position. Fig. 2—Parts in cranking position

operator should fail to release the plunger 25 immediately upon starting of the engine, the construction is such that no damage to the drive will result.

CAPABLE of being reversed and disengaged without danger of sticking, a clutch has been developed by Gebhard Jaeger, involving a simple arrangement of parts. It has been

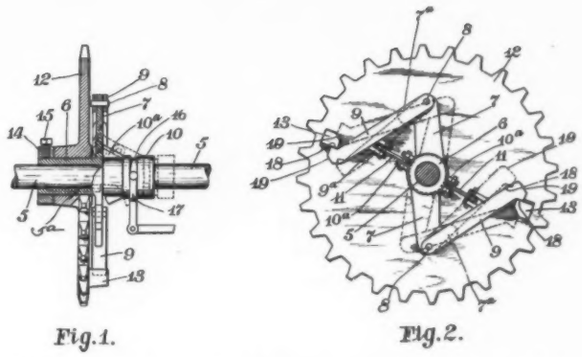


Fig. 1—View of driving member, showing clutching device. Fig. 2—Operating mechanism of clutch

granted patent No. 1,777,168 and assigned to Jaeger Machine Co., Columbus, O. A side view of the driving member and clutching device is shown in Fig. 1. Fig. 2 shows the operating mechanism of the unit.

When the shaft 5 is driven and it is desirable that the sprocket wheel 12 shall remain idle, the sleeve 10 is moved away from the wheel 12, as shown by the broken lines in Fig. 1. In this position the arms 9 are kept drawn inwardly so that they will pass lugs 13—13. Conversely, when it is desired to drive the sprocket wheel 12 the sleeve 10 is moved toward the wheel, as shown by the full lines in Fig. 1, through the links 11—11. This action moves the arms 9 outwardly, placing the clutch heads of the arms in position to engage the lugs and thereby drive the wheel 12.

The wheel can be driven either to the right or to the left, according to the direction of rotation of the shaft.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

ALLOY FOR ELECTRICAL CONTACTS—1,779,903. A contact element composed of an alloy comprising as essential elements palladium and a minor percentage of copper. Western Electric Co. Inc., New York.

CHANGE SPEED DEVICE—1,774,618. Comprising a driving and driven shaft, driving and driven gears, one of which is internal and the other external, a compound gear for connecting said shafts for geared drive and housings. Assigned to Morse Chain Co., Ithaca, N. Y.

ELASTIC FLUID TURBINE—1,779,417. This unit incorporates a diaphragm disposed in a cylinder, the cylinder wall and the diaphragm being formed with registering recesses. Assigned to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PISTON—1,779,166. The combination with a piston, of members cast integral with said piston and extending longitudinally thereof inside the wall of the piston in which ring grooves are cut. Assigned to Reo Motor Car Co., Lansing, Mich.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

ELECTION of Harvey N. Davis as one of the vice presidents of the American Society of Mechanical Engineers recently was announced. Dr. Davis, third president of the Stevens Institute of Technology, engineer and scientist, was born in Providence, R. I., June 6, 1881, and was graduated from Brown university with a bachelor of arts degree in 1901. Through post graduate work he obtained his higher degrees from Brown in 1902, and Harvard in 1903 and 1906. In 1910 Dr. Davis was made assistant professor of physics at Harvard and professor of mechanical engineering in 1919, holding this chair until 1928 when he was elected president of Stevens Institute. Inventions to his credit include an improvement in steam turbines and five processes with apparatus for the liquefaction and rectification of air.

HAILED as one of the world's greatest scientists and engineers, Prof. Elihu Thomson recently celebrated the fiftieth anniversary of his career. He is director of the Thomson research laboratory of the General Electric Co. at East Lynn, Mass. In 1878 Prof. Thomson, then about 25 years of age, designed an experimental dynamo. Later he developed an improved type of dynamo for commercial use, this becoming the standard Thomson-Houston generator for 15 years. Other inventions were forthcoming and many of the basic ideas behind them are in use today. In the mechanical field Prof. Thomson collaborated with the late Prof. Edwin J. Houston in the design of a practical cream separator employing centrifugal action, later working out the uniflow steam engine.

NUMEROUS authoritative articles on engineering subjects have come from the pen of J. M. Watson who will head the American Society for Steel Treating in 1931. His nomination was announced at the recent meeting of the organization at the Metal congress in Chicago. Of his 20-year metallurgical career in the automotive industry, Mr. Watson has been with the Hupp Motor Car Corp., Detroit, since 1914. Born in Providence, R. I., Nov. 26, 1883, Mr. Watson attended public school there as well as at Detroit. He was graduated from the University of Michigan in 1909. During the World war when his company built tanks for the government Mr. Watson's accomplishments were outstanding.

THROUGH contact with problems in engineering and design, Victor W. Peterson early perceived such as one of the key to success in the industrial world. His recent election as president and general manager of the Shafer Bearing Corp., Chicago, places him still closer to these fundamentals. In his early career Mr. Peterson designed a mechanical system for mixing and premelting sugar and corn syrup. Besides his new responsibility he also serves as the chief executive of the Sherman-Manson Mfg. Co., and the Hannifin Mfg. Co., which specializes in design and construction of air operated machinery. Perhaps the most interesting unit developed under his supervision is the four-jaw duplex chuck.

PROMINENT as physicist of the Westinghouse research laboratories, Dr. Ing. A. Nadai once was professor of applied mechanics at the University of Gottingen, Germany. His thorough technical training is reflected in an interesting paper on "Effects of Loads on Ductile Metal," presented at the recent National Metal congress at Chicago. Born in Budapest, Hungary, in 1883, Dr. Nadai was graduated as a mechanical engineer from the Technical university, Zurich, Switzerland, in 1906. He received his doctor of engineering degree at the Technical university, Berlin, in 1912. Besides his connection with Westinghouse, Dr. Nadai is a member of the faculty of the graduate school, University of Pittsburgh.

FORMERLY manager of engineering and sales Fort Pitt Steel Castings Co., McKeesport, Pa., Charles A. Lynch recently was appointed vice president and general manager of the Foote Co. Inc., Nunda, N. Y. He has been identified with the steel castings industry for 23 years and for the past five has been engaged in an intensive study of machinery and equipment materials. When the United States entered the late war

Leaders in Design, Engineering and Research

HARVEY N. DAVIS

PROF. ELIHU THOMSON

J. M. WATSON

V. W. PETERSON

DR. ING. A. NADAI

CHARLES A. LYNCH

Mr. Lynch went to Pittsburgh in charge of government inspection and procurement of steel castings for ordnance work west of Philadelphia. At the termination of the conflict he joined the Fort Pitt company, remaining in that association for 11 years.

* * *

Carl G. Ohlson, with Youngstown Sheet & Tube Co., Youngstown, O., for 15 years, the last five as consulting engineer, has been appointed assistant to J. W. Sheperdson, vice president, Morgan Construction Co., Worcester, Mass.

* * *

C. A. McCune has been elected director of research and a member of the board of directors of the recently organized Welding Engineering Research Corp. Previously he was connected with the American Chain Co., Bridgeport, Conn., and its affiliated concern, the Page Steel & Wire Co.

* * *

B. F. Hirschfeld, who is research engineer with the Detroit Edison Co., Detroit, has been selected to conduct an extensive investigation of car design problems under the auspices of the President's conference committee of the American Electric Railway association.

* * *

The Marchese Guglielmo Marconi, inventor of wireless telegraphy and Italy's most famous scientist, has been named a member of the Italian Academy, and is expected to be appointed president of the institution by Premier Mussolini to succeed Signor Tittoni.

* * *

Oscar R. Kroell has been appointed chief mechanical engineer, New England Fuel & Transportation Co., and Mystic Iron Works.

* * *

Charles T. Plastow has accepted a position as tool designer with the Truscon Steel Co., Cleveland. He formerly was associated with the Hupp Motor Car Corp., Cleveland, in a similar capacity.

* * *

Carl A. Johnson, president of the Gisholt Machine Co., Madison, Wis., was re-elected president of the National Machine Tool Builders' association at the recent meeting held at Lenox, Mass. Robert M. Gaylord, president, Ingersoll Milling Machine Co., Rockford, Ill., was made first vice president, Clayton R. Burt, president, Pratt & Whitney Co., Hartford, Conn., second vice president, and George E. Randles, president, Foote-Burt Co., Cleveland, treasurer.

* * *

Charles H. Wise, formerly designer with the Landis Machine Co., Waynesboro, Pa., recently was appointed sales engineer with the Pratt & Whitney Co., Hartford, Conn.

* * *

Fred E. Kling, chief engineer of the Youngstown district of the United States Steel Corp., recently was made chief engineer of the Carnegie Steel Co., succeeding Sydney Dillon, who has been promoted to assistant to the president.

* * *

B. H. Johnson was elected president of the Gray Iron institute at the recent convention of that organization in Cleveland. Mr. Johnson is associated with the Florence Pipe Foundry & Machine Co., Florence, N. J.

* * *

Harold Nutt has been appointed chief engineer of the Durant Motor Corp., replacing Roy E. Cole, resigned. Mr. Nutt has been associated with the engineering department of the corporation for more than eight years.

* * *

Prof. C. Derleth Jr. has been appointed dean of the reorganized engineering colleges of the University of California at Berkeley. Prof B. M. Woods will be head of the mechanical engineering department, while Prof. L. F. Fuller is to have charge of the electrical engineering department.

* * *

Morris Stone, mechanical engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has received the second award of the Benjamin Garver Lamme scholarship, providing one year advanced study at any American or foreign college or university.

* * *

H. A. Huebotter, formerly research engineer in the Waukesha Motor Co., Waukesha, Wis., recently was appointed an instructor in automotive engineering at the General Motors Institute of Technology, Flint, Mich.

* * *

Oliver Smalley, consulting engineer, Brooklyn, N. Y., has been engaged as director of research of the Gray Iron institute. He will have charge of the development of standards for

(*Concluded on Page* 74)

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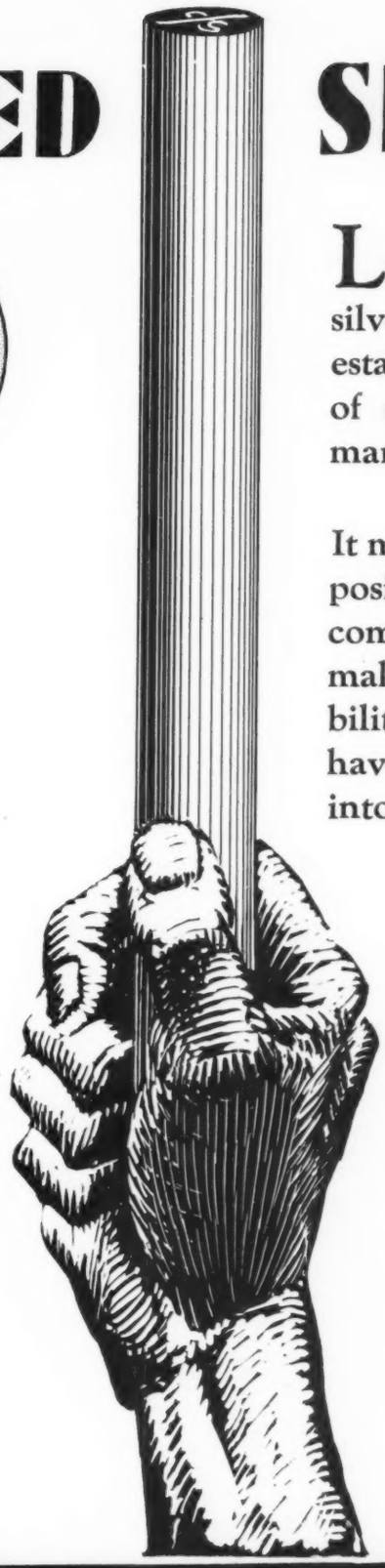

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COLUMBIA

COLD FINISHED BARS AND SHAFTING

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

A SURVEY of all available literature in the field of iron alloys just has been announced by the Engineering Foundation at New York. Advance in this field is considered fundamental for American industry and to assist in the program of research over 60 industrial and scientific organizations have been enlisted. A fund of $230,000 has been contributed to make the project possible. This promises to be the most imposing bibliography of iron and steel ever attempted. A tentative list includes 2000 journals in ten languages published since 1890 in 25 countries. Books also will be included in the review.

* * *

Packard Laboratory at Lehigh Is Dedicated

Prominent leaders in science and industry participated in the dedication of the James Ward Packard laboratory for electrical and mechanical engineering at Lehigh university, Bethlehem, Pa., on Oct. 15. At the ceremony tribute was paid to the late pioneer electrical and automobile manufacturer whose gift of $1,200,000 made the laboratory possible.

Speeches made by industrialists and educational men extolled the significance of research which bears an infinitely close relation to the design of machinery. Importance of technical education to future prosperity also was stressed. The dedicatory address was delivered by Charles M. Schwab, chairman of the board, Bethlehem Steel Corp., and a trustee of Lehigh university.

* * *

Gear Manufacturers Convene in Canada

Papers of fundamental technical importance and interest were presented at the recent fourteenth semiannual meeting of the American Gear Manufacturers' association at Niagara Falls, Ont. Standardization again was one of the outstanding subjects under discussion, and to this cause C. B. LePage, an assistant secretary of the American Society of Mechanical Engineers, contributed a paper, "A Look Ahead in Gear Standardization and Research."

Resistance of nitrided surfaces to wear was a salient feature of a paper on "Nitro-alloy Steel," by Prof. V. O. Homerberg, Massachusetts Institute of Technology. Data of test revealed that wear on a cast iron automobile cylinder after 18,600 miles was 0.016-inch, while nitrided cylinders during the same length of service showed wear of only 0.0008-inch. Prof. Earle Buckingham cited tests in which it was indicated by the surface of nitrided gears that they could carry stresses about 25 per cent higher than case hardened gears.

* * *

New Standards for Motors Are Adopted

Through its standards committee the National Electrical Manufacturers association recently adopted new standards for motors. Revised and existing standards were approved for engine-driven alternators, planer type motors, elevator motors and motor generators, drip-proof fully protected motors, crane motors, oil circuit breakers, switching equipment, transformer impedance and attachment plugs.

* * *

Tool Builders Meet and Discuss Problems

In directing its efforts toward a $400,000,000 replacement market during the next five years the Machine Tool Builders' association takes a definite step in the direction of new design. While the twenty-ninth annual meeting at Lenox, Mass., Oct. 12-15 dealt more particularly with the business aspect of the industry the technical side of the situation was not overlooked.

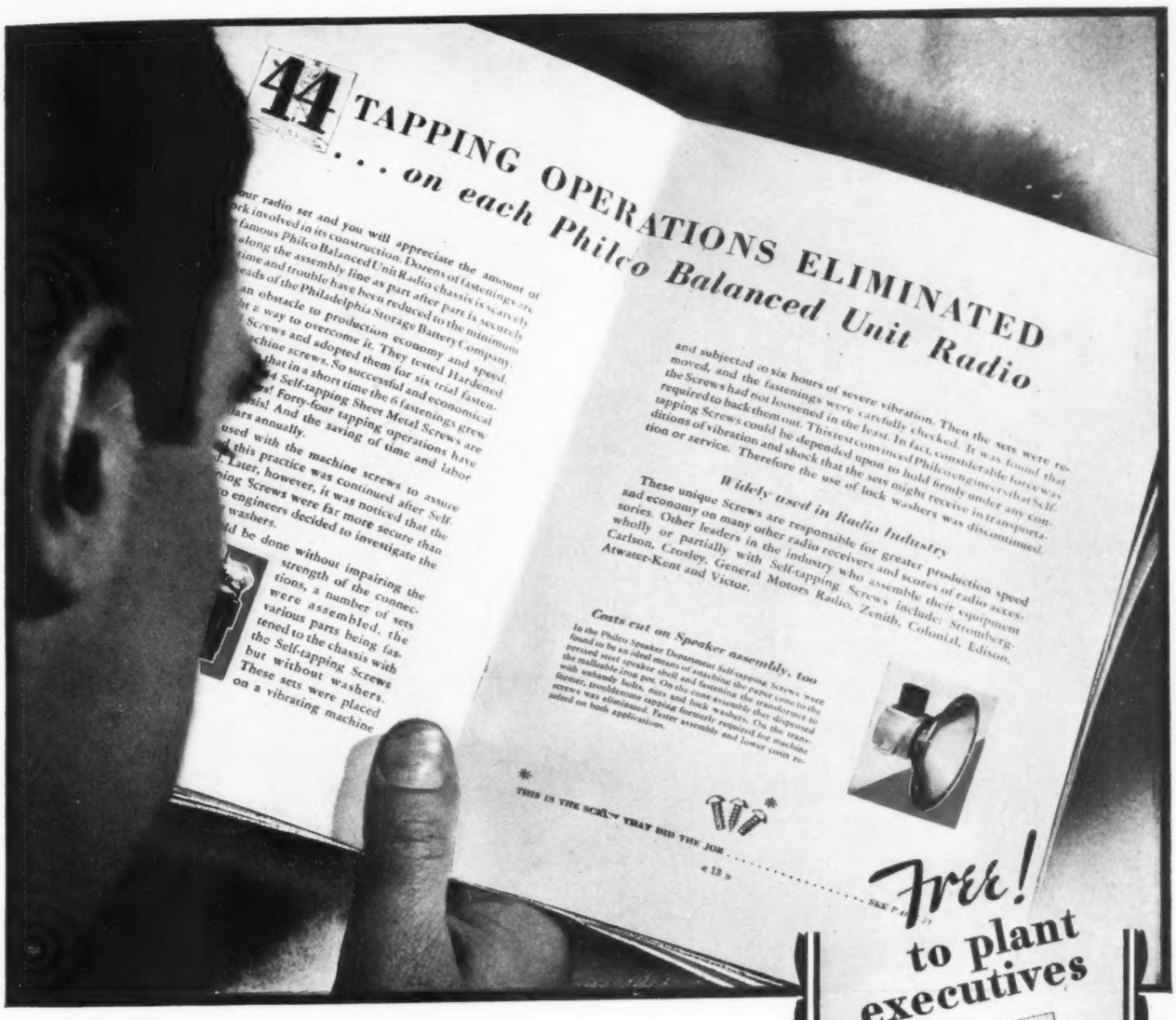
It is conceded that design is going to play an important part in selling new tools. Among the future improvements will be greater automaticity in gaging the work and in adjusting to close limits through relays from the gaging apparatus. Refinements in bearings and gears to combat vibration and eliminate noise are other features which future design will bring out.

Officers elected at the meeting comprise a well balanced staff of both technical and business men.

* * *

Arc Welding Prize Contest Is Announced

Designers and engineers in every industry, where iron and steel forms all or a part of the manufactured product, again are given the opportunity by Lincoln Electric Co., Cleveland, sponsors of the second Lincoln arc welding prize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This booklet contains accurate descriptions of the ways in which greater fastening economy has been attained on the Servel Refrigerator, Philco Radio, Hotpoint Range, Ford Trimotor Plane, Simmons Metal Furniture, Zenith-Detroit Carburetor and other well known products. All of the facts and figures given, were secured through fastening studies made by independent engineers in the plants of fourteen of the most prominent concerns in their respective fields.

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competition, to show their skill and ingenuity in utilizing arc-welded construction. As a reward for their efforts $17,500 will be awarded for the 41 best papers submitted in the contest. The jury of awards to judge the papers entered will be composed of the electrical engineering department of Ohio State university under chairmanship of Prof. Erwin E. Dreese, head of the department, and such others as he may select.

The purpose of this competition is to stimulate designers and engineers in every line of industry to think of the possibilities of arc welding and to increase their knowledge of the feasibility of its application. Prizes to be given the winners are: First, $7,500; second, $3,500; third, $1,500; fourth, $750; fifth, $500; sixth, $250; and for the seventh to forty-first prize papers $100 each. The competition will be open to any person in the world except the employees of the sponsors. The closing date for the competition will be Oct. 1, 1931.

* * *

Dairy Exposition Shows Design Progress

Industry devoted to the manufacture of dairy and ice cream machinery is showing a keen interest in design. This fact was disclosed by the $1,000,000 Dairy Industries exposition held at Public auditorium, Cleveland, Oct. 20-25.

Indicative of the trend in design is the fact that many instances could be observed in which machines are being designed vertically instead of horizontally to conserve floor space and to facilitate shipment and installation. Other characteristics of the newer machines are the elimination of inaccessible parts which retard the cleaning process and the tendency toward simple design incorporating plain instead of fancy or interrupted surfaces.

Corrosion-resistant alloys are finding increased application in this class of machinery. The trend toward automaticity has brought about the use of hydraulic and vacuum operations, motor control, feeding devices, the electric eye, new types of bearings and many other interesting features of design. Papers presented at the various meetings held in connection with the exposition covered standardization of dairy machinery, research as applied to dairy machinery and engineering principles involved in the design of this type of equipment.

* * *

More Roller Bearings in Railroad Service

Equipped with self-aligning roller bearings, 15 combination baggage and mail cars built for New York, New Haven & Hartford railroad have completed six months of satisfactory service. The unit with the bearings used on these cars takes the A.R.A. standard 6 by 11-inch journal box and wedge. An axle bearer of cast iron, however, is substituted for the standard A.R.A. brass journal bearing, as axle does not rotate.

Lubrication is supplied to the bearings through a fitting in the end of the axle. Ordinary car oil is used and the initial charge of two pints was made at the time the cars were placed in service. This charge, it is estimated, will be sufficient for a period of at least six months or approximately 50,000 car-miles. About one-half the initial charge is added each time the bearings are given lubrication attention.

* * *

Chicago to Get 1931 Foundrymen's Convention

The annual convention and exhibition of the American Foundrymen's association in 1931 will be held at Stevens hotel, Chicago, during the week of May 4, according to the decision of a special committee appointed to consider the question. A limited supply of foundry equipment and supplies has been scheduled for the 1931 meeting, N. K. B. Patch, president of the association, announced.

The special committee also recommended that the 1932 annual convention and exhibition be held in Philadelphia in the new convention hall which now is under construction. A large exhibition of equipment is planned in connection with the Philadelphia meeting. It also was recommended by the committee that all future meetings be held the first full week in May.

* * *

Speaker Suggests Interchange of Ideas

In addressing a conference recently, Dr. Dugald C. Jackson, head of the department of mechanical engineering of Massachusetts Institute of Technology, declared that industry might profitably throw open its doors to the reception of a larger number of engineering professors and students during the summer months. The outsider might bring in fresh viewpoints to aid in eliminating improper practices and subsequently absorb ideas of commercial practice, helping his future teaching and making it more valuable to the student.

* * *

Textile Machinery Undergoes Development

That the textile industry is experiencing the greatest amount of development in its equipment in many decades was made manifest at the recent textile exposition at Greenville, S. C. As in other fields automaticity is to the fore and new materials as well as improved bearings and mechanisms are being employed.

One of the more recent developments is an automatic coupling unit, especially adaptable for spinning-frame drives. Upon starting, the motor is free to attain full speed in its normal time, subsequently setting in motion an auxiliary actuator which closes the play between two disks. By slight friction a cam carrier is motivated, causing it to accelerate to the eventual speed of the coupling. Reduction of starting torque is one of the principal advantages of this unit.

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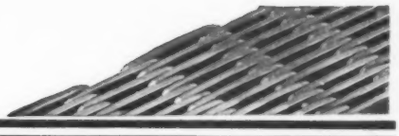

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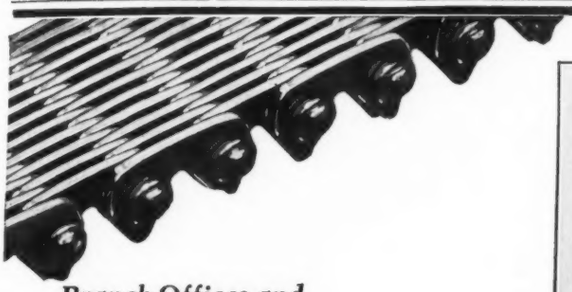

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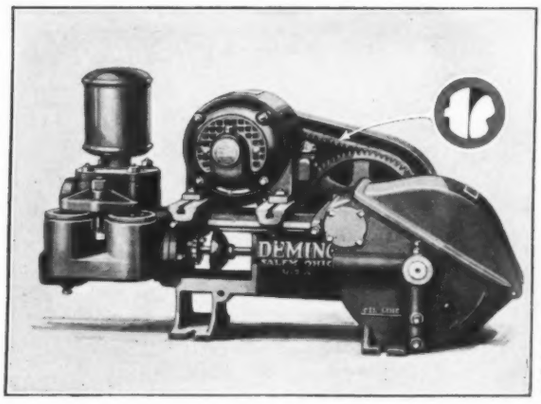
LOS ANGELES.....CALIFORNIA
J. W. Minder Co.
LOUISVILLE.....KENTUCKY
E. D. Morton Co.
MINNEAPOLIS.....MINNESOTA
Strong-Scott Mfg. Co.
NEWARK.....NEW JERSEY
Dodge-Newark Supply Co.
NEW YORK CITY...NEW YORK
NEW ORLEANS.....LOUISIANA
A. M. Lockett Co.
OMAHA.....NEBRASKA
D. H. Braymer Equipment Co.
PITTSBURGH..PENNSYLVANIA
PHILADELPHIA.....PENN.
PITTSBURGH..PENNSYLVANIA
Tranter Mfg. Co.
ROCHESTER.....NEW YORK
John M. Forster Co.
SEATTLE.....WASHINGTON
Star Mach. Co.
ST. LOUIS.....MISSOURI
Bates Sales Co.
SAN FRANCISCO..CALIFORNIA
Adam-Hill Co.
TORONTO.....ONT., CANADA
Strong-Scott Mfg. Co.
WINNIPEG.....MAN., CANADA
Strong-Scott Mfg. Co.



Morse Silent Chain used as standard equipment on Deming Pumps.

Morse Power Transmission Service is nation-wide. This service has been designed to give helpful, accurate information on power transmission methods. Morse engineers know what conditions are a cause of waste and how to correct faulty power transmission installations that eat into profits. They will be glad to make an expert survey of conditions in your plant, and present you with a clear, concise picture of your power transmission efficiency. Morse Service has been responsible for increased efficiency, faster production and lowered operating and maintenance costs in almost every line of industry.

Morse Silent Chain Drives, Flexible Couplings and Speed Reducers, installed as a part of Morse Power Transmission Service have an outstanding reputation for long life and trouble-free operation.

Call in the Morse Engineer. A 'phone call will bring him to your plant. Send for the free Morse Data File.

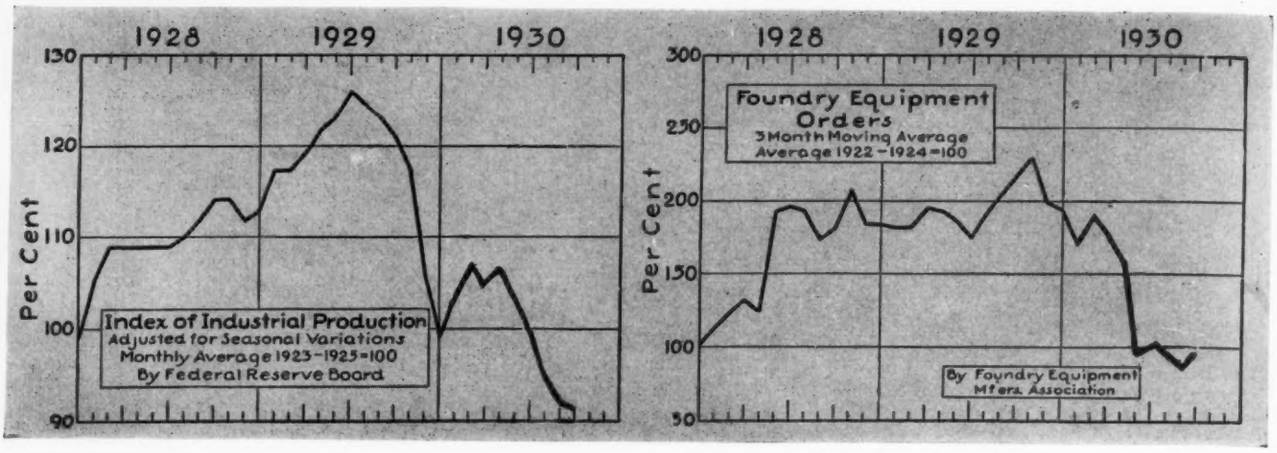
MORSE CHAIN CO., ITHACA, N. Y.

Manufacturers of Morse Silent Chain Drives, Flexible Couplings and Chain Speed Reducers

BRANCHES IN PRINCIPAL CITIES

MORSE SILENT CHAIN DRIVES

Visit the Morse Chain Company Exhibit at the Power Show, New York City, December 1-6, 1930. Booth 267-268

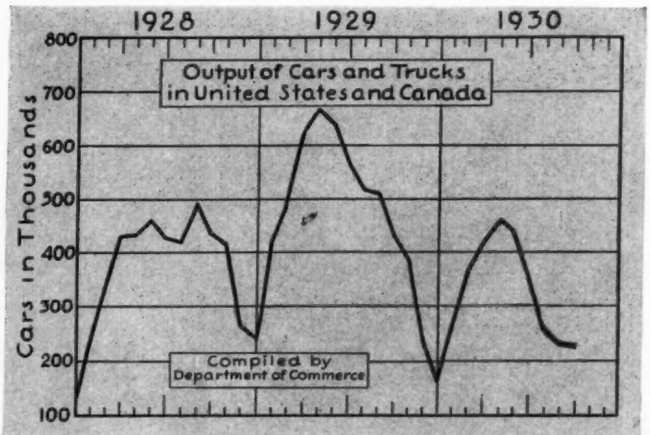


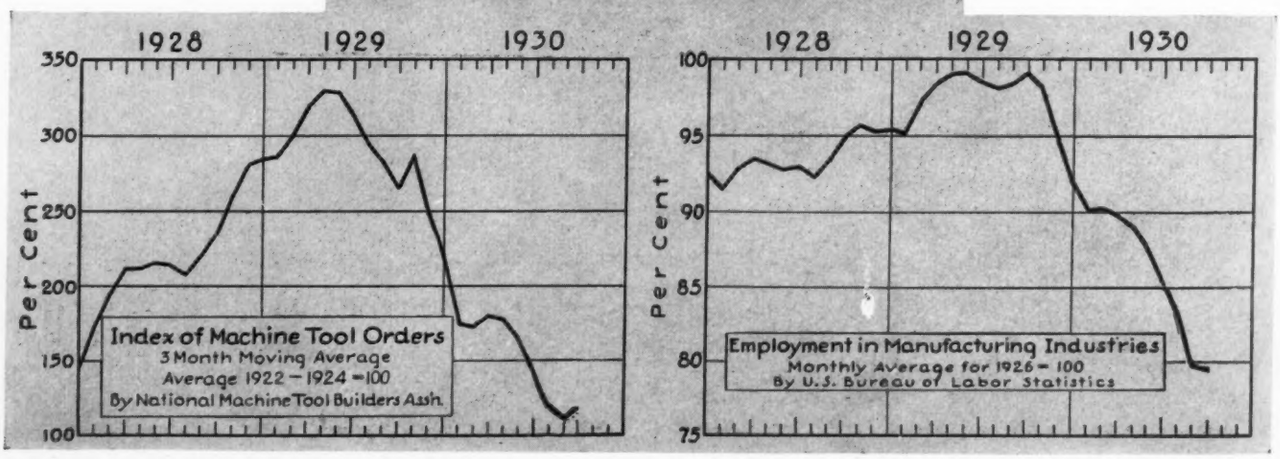
How Is Business?

DISAPPOINTING factors in the business situation have obstructed the road to recovery and momentum gained early in the fall has been lost in the recent relapse in industrial activity. There are, however, indications that a firm foundation is being established for future prosperity, but progress doubtlessly will be irregular.

Farm machinery manufacturers meeting in Chicago recently expressed the opinion that their industry should recover its equilibrium with a fair degree of speed. Members of the National Association of Manufacturers predict a slow but steady improvement, while the president of the National Association of Purchasing Agents believes that commodity prices have hit bottom and marked improvement in prices will appear next spring. Machine tool conditions generally, fail to show improvement. However, the launching of nationwide employment relief measures, particularly public works, promises to increase machine tool sales to companies engaged in manufacture of tractors, road machinery, etc. The automotive industry continues to mark time.

Depression of business, while reducing the tonnage of ferroalloys as a whole, is working to the benefit of industry through more extensive applications of alloy steels in machinery. Slack business has prompted many machinery manufacturers to study redesign. In this process they have turned frequently to alloy steels with the hope that improvements will win customers.





Dependably yours

because I am made by special machinery, with the greatest precision and care—because I am tested seven times while they are making me—because I am tested after that at more than my rated capacity—because I am sound in construction and safe in operation—because, by a new principle, I check the arc before it starts, thus minimizing gas and contact burning—because, in short, I am the

A-30 AIR MOTOR STARTER

Hardly an Arc–Only a Spark

CONDIT ELECTRICAL MFG. CORPORATION

838 Summer Street, BOSTON, MASSACHUSETTS, U.S.A.

CONDIT

NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Announces New Reduction Gears

SPECIALLY designed ball bearings eliminate the need for stuffing boxes on the new speed reducers recently announced by Winfield H. Smith Inc., Springville, N. Y. Reduction gears Nos. 2B and 3B are for use with 1/8 horsepower motors and employ antifriction bearings throughout. Model 2B can be furnished with ratios of 48 to 1, 30 to 1, and model 3B in ratios 20 to 1, 10 to 1 and 5 to 1.

Model 2B reduction gear for use with 1/8 horse power motors is equipped with antifriction bearings

No. 2DB also was added to the line recently and is available in reduction ratios of 400 to 1200 to 1 and 100 to 1. It has a double worm gear drive capable of transmitting a torque of 150 inch pounds. Radial thrust ball bearings are employed on the high speed shaft, ball thrust bearings on the intermediate shaft and plain bearings on the slow speed shaft.

Develops New Industrial Finish

UNUSUAL significance among paints and varnishes is expected to be attained by a new product known as DuLux, recently announced by E. I. du Point de Nemours & Co., Wilmington, Del. Several years of research were spent by the company's chemical and technical staffs to impart some of the outstanding advantages of Duco to finishes of the paint and varnish type.

DuLux now is available for industrial uses, including the finishing of machinery, coating of structural steel and other applications where resistance to corrosion and weathering is required. The product is based on a film-forming material that is a specially developed synthetic chemical compound exceptionally resistant to disintegration. Its drying time is much shorter than that of ordinary finishes, it is claimed, thus greatly reducing the interval during which freshly coated surfaces are subject to marring.

Photo-Electric Line Is Increased

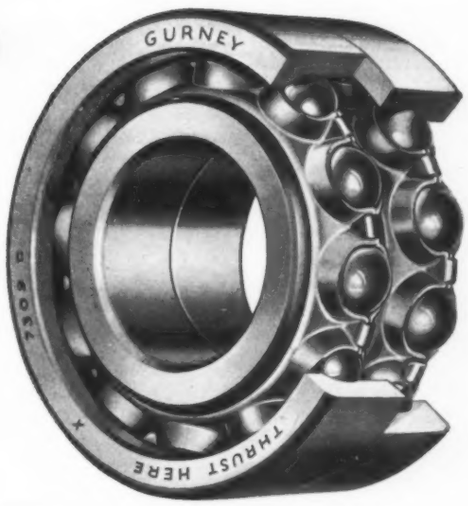
NEW units recently were added by General Electric Co., Schenectady, N. Y., to its line of photo-electric relays for the control of industrial machinery and other devices. These are introduced as an addition to the original unit designated CR-7505-A-2, an alternating current relay. Units now are provided for a large variety of applications, both indoors and outdoors. The photo-electric relay is a device which functions to control electrically operated equipment as a result of a change in the intensity of light.

Type CR 7505 photo-electric relay mounted on pedestal. Newly introduced units meet a variety of applications, both indoors and outdoors. Control of electrically operated equipment is attained as a result of a change in intensity of light

The new direct current relay, CR-7505-B-1, can be supplied for any standard, commercial voltage. It is a counterpart of the alternating

After 16 Years

Industry has caught up with This Bearing



Sixteen years ago Gurney manufactured the first Duplex Ball Bearing. It was a war-time measure—a bearing developed to secure great spindle rigidity so that giant turret lathes might process long-range shells with unvarying accuracy.

Not many machine tools of the following era required the extreme rigidity, enormous load capacity and high speed that this bearing affords. Now, however, the call for spindle rigidity and greater production in modern machine tools has increased the demand for Duplex efficiencies.

Gurney Duplex Ball Bearings represent sixteen years of progressive engineering development—involving not only the bearing itself but the special Duplex grinders required for its manufacture. Consider carefully the value of these sixteen years of Duplex experience when selecting a spindle bearing to insure lasting rigidity for your machines. GURNEY BALL BEARING DIVISION, Marlin-Rockwell Corporation, Jamestown, New York.

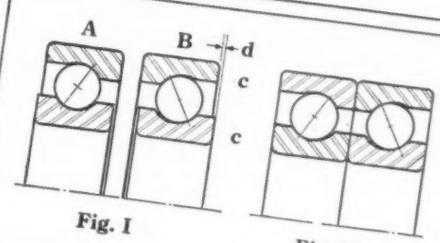


Fig. I

Fig. II

The Duplex Ball Bearing is composed of two units (*a* and *b* Fig. I) that function as one bearing. Each unit is a bearing in itself, the rings of which have their faces (*c-c* Fig. I) ground parallel on a special machine called the "Duplex Grinder". To accomplish this, the bearing is temporarily assembled and a small initial thrust load imposed on one side of the outer ring. While under this pressure the faces are ground flush. After the pressure is released the outer ring will recede by a small amount (*d* - Fig. I). When mounted, (Fig. II), the clamping pressure again draws the faces parallel automatically applying the initial load which accounts for the great rigidity of the Duplex Ball Bearing.

GURNEY BALL BEARINGS

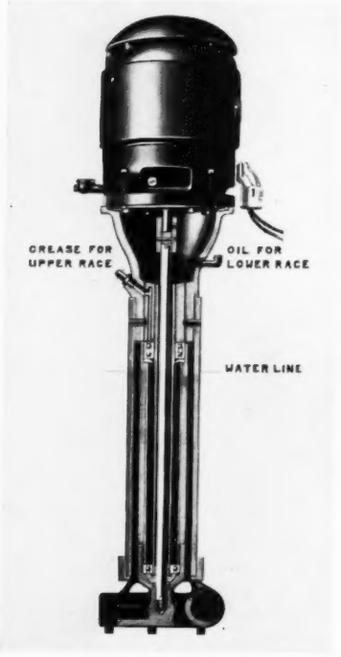
current relay, CR-7505-A-2, already on the market, except that it operates on direct instead of alternating current, and can be used for similar service. CR-7505-C-2 relay is a unit similar to the A-1 and B-2, alternating current and direct current types, but is enclosed in a cast iron case to make it weatherproof for outdoor use. Interior light control unit, CR-7505-D-1, is a photoelectric unit for turning inside lights on or off according to the amount of illumination from the outside.

The new measures devices, CR-7505-E-1 and F-1, alternating current and direct current respectively, are similar to the two-unit relays except that the relays themselves are omitted. The two new light sources, CR-7500-A-1 and B-1, for indoor and outdoor use, respectively, can be used in connection with standard relay units to provide light up to a distance of 25 feet in applications where the control is to function as a result of the interruption of that light.

Designs New Type Coolant Pump

ENTIRELY new in design, the Brownie coolant pump recently announced by Tomkins-Johnson Co., Jackson, Mich., incorporates a number of interesting features. There are no packings to leak or screens to clog and coolant cannot come in contact with the ball bearings.

Drive shaft, impeller and protector tube are one unit and revolve together. The intake is

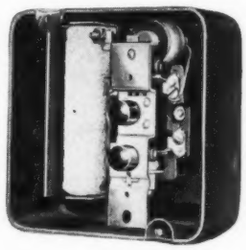


Coolant pump in which drive shaft, impeller and protector tube are one unit and revolve together. Unit is equipped with a direct motor drive which develops a speed of 1725 revolutions per minute

at the top of the impeller and coolant never is forced upward between housing and protector tube. The pump handles a heavy mixture of coolant with grit and chips as efficiently as clean oil, it is claimed. Units are manufactured in two sizes, No. 1 and 2. The former has a capacity of 50 gallons a minute and the latter 15 gallons. Direct motor drive at a speed of 1725 revolutions per minute is another feature. Pumps made of acid-resisting metal can be furnished.

Announces Resistor Type Starter

ANNOUNCEMENT has been made by Cutler-Hammer Inc., Milwaukee, of a new resistor type starter for fractional horsepower, direct current and single phase, alternating current motors. This new starter is designed for those applications where power company



View of interior of resistor type starter. Enclosing case may be mounted on machine or any other point convenient to the operator

rulings require that the inrush of current of small motors connected to lighting circuits, be held within definite limits and where the high inrush current incident to starting across-the-line is otherwise objectionable.

On starting, a resistance is inserted in series with the motor. As the motor accelerates and the inrush current decreases, the starter automatically short-circuits the resistor, connecting the motor across-the-line. The starter is push-button operated and provides thermal overload protection to the motor.

The enclosing case for this new starter is a standard double wiring box which can easily be mounted on the machine, on the wall, or at any other point convenient to the operator. Starters can also be obtained without the enclosing case for building into the pedestal or other part of a machine. Maximum horsepower ratings are ¼ horsepower, 115 volts, direct current, and ¾ horsepower, 110 or 220 volts, alternating current.

Motors Meet Hazardous Conditions

A NEW line of totally-enclosed, fan-cooled motors for hazardous conditions recently was announced by General Electric Co., Schenectady, N. Y. The polyphase induction motors at present embrace ratings from ¾ to 30 horsepower in popular speeds and is especially designed for use in explosive gas conditions such as are found in gasoline refineries, garages, gasoline stations, chemical plants, dry cleaning

Limit Switches which co-operate with Motor Control

THE dependable operation of Motor Control in many cases depends upon the control-accessories. So does production. With the failure of *one* limit switch, your processes can be snarled up . . . halted . . . the value of an investment of thousands of dollars impaired. Therefore, when you select limit switches make your choice with the utmost care . . . make sure that these accessories actually help your control perform its duty.

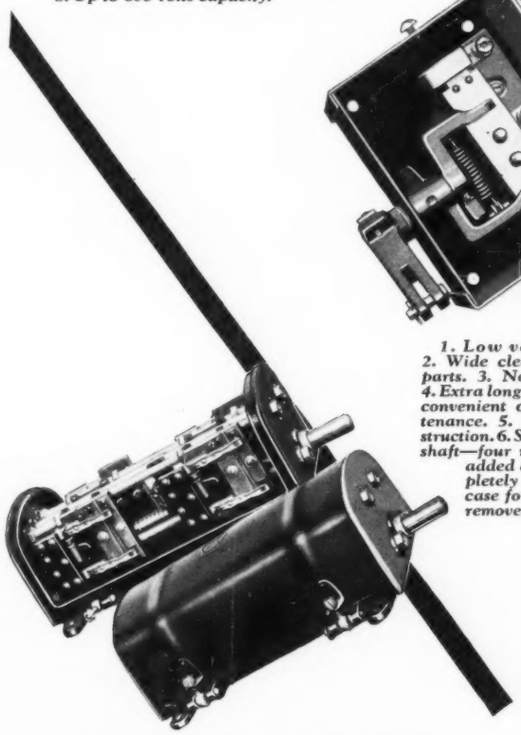
The Cutler-Hammer Line of Limit Switches has been designed and built with full realization of the responsibilities placed upon this equipment. They are the fruits of 30 years' intimate contact with the needs of American Industry . . . the fruits of 30 years' experience in the electrical control field. They are built to the highest standards of ruggedness, durability and performance. You are invited to investigate this line carefully . . . and to see how you and your production can depend on it . . . for all time. A letter will bring you further information.

C-H LIMIT SWITCHES
BULLETIN 1271

1. Can be used on doors, machines, conveyors, etc. 2. Push-button, roller-lever or gravity operation. 3. Right or left-hand mounting; normally open or normally closed contacts, for wide variety of uses. 4. Rugged construction for long service. 5. Easily renewable contacts. 6. Dust-proof case. 7. Double-break protection against shorts, etc. 8. Up to 600 volts capacity.

C-H LEVER-OPERATED MASTER SWITCH
BULLETIN 10252

1. Low voltage protection. 2. Wide clearance between live parts. 3. Non-stubbing contacts. 4. Extra long bronze bearings with convenient oil holes—low maintenance. 5. Simple, rugged construction. 6. Square operating lever shaft—four mounting positions—added adaptability. 7. Completely enclosed extra heavy case for safety. Cover easily removed.



C-H TRAVELING CAM LIMIT SWITCH
BULLETIN 10312

1. Wide range of adjustment, extreme accuracy in stopping. 2. Double-pole contacts prevent accidental grounds or shorts. 3. Contacts, quick break type; when adjusted to the tripping point can be positively locked to that position. 4. Rugged construction throughout. Bearings bronze-bushed. Dust-proof cover. 5. Contacts and fingers are standard C-H construction.

C-H CRANE SAFETY LIMIT SWITCH
BULLETIN 10111

1. Compact size—mounting in 4 positions. Easily wired. 2. No pilot circuit required. 3. Dynamic braking, quick positive stopping. 4. Quick acting contacts—automatic reset. Contacts and shields easily renewable—interchangeable with standard mill type contactor parts. 5. Rugged construction throughout. 6. Tripping weight an integral part of switch. 7. Built in two sizes.

CUTLER-HAMMER, Inc.
Pioneer Manufacturers of Electric Control Apparatus
1320 St. Paul Avenue
MILWAUKEE, WISCONSIN

CUTLER HAMMER

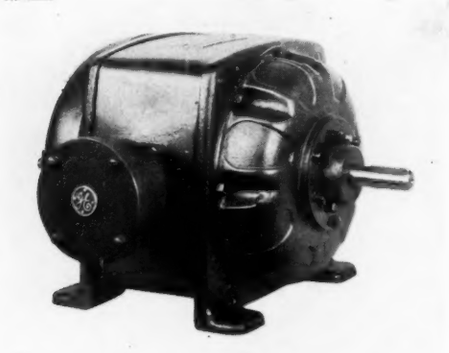
C-H

The Control Equipment Good Electric Motors Deserve

(A-284)

establishments, paint factories, alcohol plants and similar locations. These motors are suitable for either indoor or outdoor operation and eliminate the necessity for fire walls and other arrangements.

In the single-phase motors there are at present ratings from ½ to 2 horsepower, totally enclosed, for the same service and fractional



Totally-closed, fan-cooled motor

horsepower ratings from ¼ to ½ horsepower, the latter either the repulsion induction type or direct-current motors. All these motors comply fully with the specifications of the Underwriters' laboratories which tested several sizes preparatory to the formal listing of the complete line as suitable for use in Class 1, Group D, and Class 2 hazardous locations.

Clutch Employs Centrifugal Force

CLUTCH pulleys and clutch couplings comprising the new line of units recently announced by Hill Clutch & Machine Co., Cleveland, employ centrifugal force in a novel

Automatic clutch coupling

manner to attain clutching effect. There are two main parts, an inner rotor carrying the impeller blades having orifices at the points where they are attached to the shaft, and an outer shell with serrations around its inner face.

The core of the device, which at low speeds turns inside the casing, has two wings or impellers which just clear the serrated surface. End plates held in place by a dust-proof snap-ring retain a quantity of chilled shot in the casing. When the clutch is at rest as shown in Fig. 1, the chilled shot lie at the bottom of the shell. On starting the motor the impeller blades revolve, driving the shot before them (Fig. 2). As the speed increases, centrifugal force acts to pack the chilled shot down tightly into the serrations.

The impeller blades begin to pickup the load as the shot accumulate ahead of them. When the motor comes up to speed these masses of shot accumulate to the extent that the impeller becomes locked to the casing as shown in Fig. 3. A simple "tell-tale" spring cam engaging with pins on the outside of the impeller unit indicates the duration of slippage at starting and announces any overloading. In event of an overloading of the driven machine the speed decreases, this causing the packed shot to slip until safe balance is reached.

The device is furnished as an automatic clutch coupling in 14 sizes, for shafts from ½ to 4¾-inch maximum diameter, and as an automatic

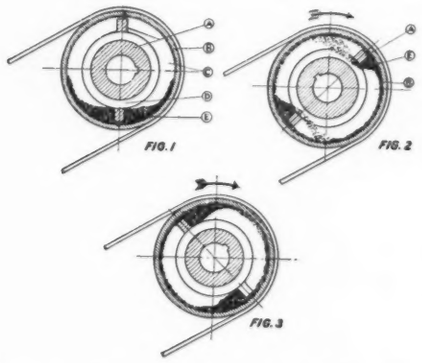


Fig. 1—Clutch at rest. Fig. 2—Unit as speed increases. Fig. 3—Clutch at full speed

clutch pulley in 17 sizes, for shafts from ½ to 4¾-inch maximum diameter. They have maximum horsepower ratings ranging from 0.7 to 122 and can be furnished for special applications such as cone pulleys, rope or V-belt drives, chain drives, etc.

Starters Have Arc Suppressors

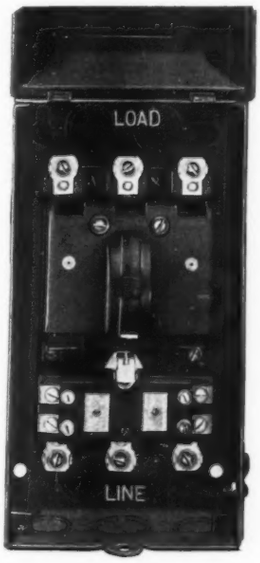
CONSISTING of an automatic starter providing low voltage and overload protection, and a quick make and break knife switch mounted in the same cabinet, a new line of starters has been introduced by the Industrial Controller division of the Square D Co., Milwaukee. Designated 8532K, 8536K and 8537 K, these units are provided with arc suppressors which greatly in-

crease their breaking capacity at the higher voltages.

The switches will break the stalled rotor current of motors within the ratings of the starters. An interlock is provided which prevents opening the door of the cabinet unless the switch is in "off" position. The automatic starters may be controlled by push buttons or automatic pilot switches. Combining of the two units in one cabinet saves considerable space.

Provides Overload Protection

A SMALL, simple, and inexpensive motor starting switch with resettable automatic overload protection, known as the WK-16 "Motor Watchman," recently was announced by the



Motor starting switch has contacts of special alloy which will not braze and are protected by a deionizing chamber. The base of the unit is molded composition

Switchgear department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Automatic overload protection is obtained by means of a method of tripping the contacts by heating a bimetallic disc which does not gradually deflect but maintains its shape up to a predetermined point. When this point is reached it snaps to another position, affording a positive tripping means. In its normal position the upper side is convex, the rim being held rigidly. When overheated, this side becomes concave. There is no intermediate point, the action being of bullet speed.

The door of this new switch is hinged at the top and can be locked to prevent tampering. The protective handle guards are arranged so that the switch may be locked in the "off" position. The operating mechanism is of the quick make and break toggle type with cadmium plated parts and noncorrosive bearings. The trip mechanism calibration and the operating time are not affected by vibration because of the positive snap action of the "Built-In-Watchman."

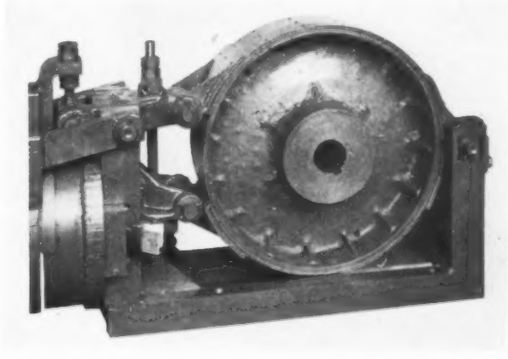
The complete overload mechanism is easily removed without changing calibration. Heater coils can be readily changed without removing the complete assembly.

Brakes Are Magnet Operated

BAND type, clapper magnet operated brakes for direct current motors have been announced by General Electric Co., Schenectady, N. Y. These brakes, designated CR-9517, were designed primarily for heavy-duty service such as cranes, steel mill auxiliaries, hoists and similar applications. Simplicity and long life are the outstanding advantages claimed by the manufacturer.

The new brake operates in the same way as the external contracting band type automobile brake. It is applied by a spring and is released by a magnet. It can be either connected to operate in synchronism with the starting and stopping of the motor, or to operate independently, one type using a series wound coil and the other, a shunt wound coil. In the case of independent action, the motor control is provided with a "drift" point which takes power off the motor but does not apply the brake.

The coil magnet can be mounted so that terminals can be brought out on either side of the brake. Coils are form wound vacuum treated and compounded in the magnet frame, thus keeping out moisture and holding them firmly. Balanced steel wheels are used. The brakes are so constructed that they can be installed where there is low headroom. Brake bands are interchangeable, both top and bottom. Braking is positive in either direction.



Heavy duty brake employs magnet

Develops New Gear Lubricant

GEAR lubricants comprising a new series for all types of heavy, slow-moving, open gears recently were developed after extensive tests by the research staff of E. F. Houghton & Co.,

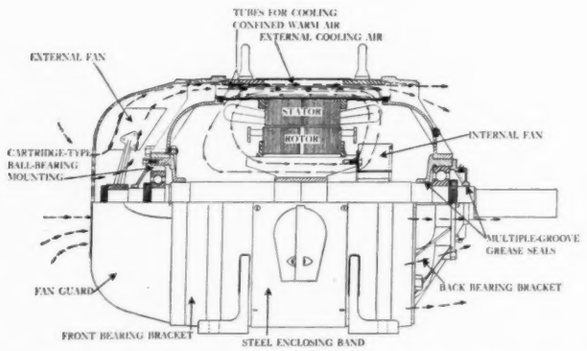
Philadelphia. These are known as Tenac Nos. 1, 2, 3 and 4, the grades running from heavy to light.

In overcoming high frictional losses and premature wear on gears the new lubricant is not thrown off the gears while they are in motion. After exhaustive tests, the research staff announces that Tenac has been tried in practically every type of gear installation and under most adverse conditions, meeting all requirements successfully.

One of the outstanding points of advantage in the lubricant series is its extremely low cold test. Tenac Nos. 3 and 4, for example, can operate satisfactorily at 20 to 25 degrees lower temperature than most gear lubricants, it is claimed. No special device or method of application is required with the use of these lubricants. They are applied to the gears in the same manner as other lubricants used for the same purpose.

Motor Employs Cooling Principle

EMPLOYING the Mossay principle of cooling, a new line of fully enclosed fan-cooled induction motors in sizes from 20 to 150 horsepower recently were announced by Reliance Electric & Engineering Co., Cleveland. This method of cooling is employed for the larger sizes because the design of the smaller motors



Direction of air in fan cooled induction motor is shown by arrows. New cooling principle is employed

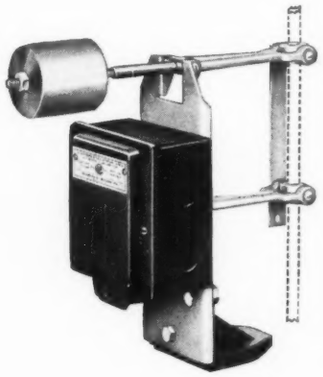
does not provide sufficient cooling area. The extra cooling surface is obtained by the use of tubes extending over the outside of the stator.

A single internal fan on the rotor circulates the confined warm air through the tubes over which are blown blasts of cool outside air from one end of the motor to the other, as indicated by the arrows in the accompanying illustration. Using this method it is possible for the company to furnish fully enclosed fan-cooled motors which are interchangeable in mounting dimensions with standard open motors of the same horsepower and speed rating.

Stator windings and rotor are enclosed tightly and fits for all enclosing parts are machined surfaces. All seals are stationary and in dismantling the units the only extra parts to remove in addition to those of the standard open motor are the external fan guard and fan.

Announces New Float Switch

TO PROVIDE automatic motor control for pumps and similar equipment supplied with float control, Allen-Bradley Co., Milwaukee, recently developed Bulletin 840 float switch. This new unit is of the contactor type operated by an



Float switch is operated by an arm working against a cam leverage, assuring quick make and break of the contactor

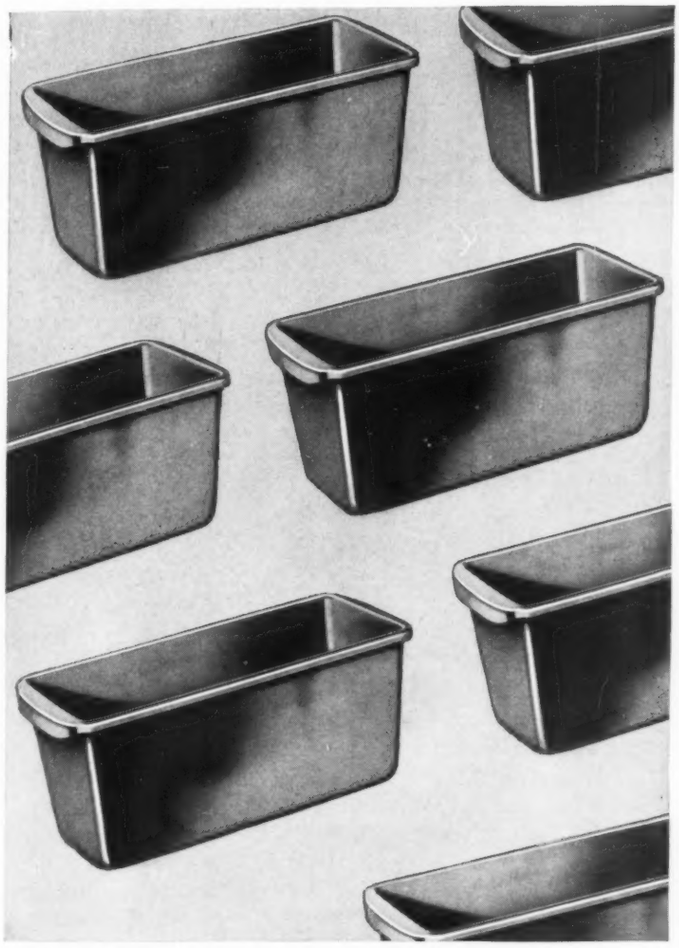
arm working against a cam leverage which assures a quick make and break of the contactor.

Bulletin 840 size B float switch is made in four forms in various combinations with or without overload breakers, disconnect switches, and fuse clips. It provides two-pole switching and handles alternating current motors up to 1½ horsepower, 110 volts and 3 horsepower, 220,440 and 550 volts; the direct current rating is 1 horsepower, 110 or 220 volts. For larger ratings the switches can be used as pilot control for magnetic starters.

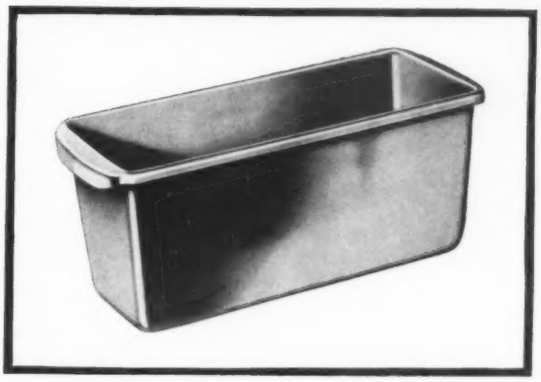
Size C float switch provides three-pole switching and is rated for single phase motors up to 1½ horsepower, 110, and 3 horsepower, 220 volts; for polyphase motors up to 3 horsepower, 110, and 5 horsepower, 220, 440 and 550 volts; for direct current service 2 horsepower, 110 and 220 volts, 1 horsepower, 550 volts.

MECHANICAL experts on the Canadian Pacific railroad have concluded successful experiments in the use of a specially manufactured rubber product as a shock absorber and noise eliminator on both passenger and freight equipment. Where metal in car trucks comes in contact with metal, composition rubber and steel pads are used. Air spaces between the rubber parts render them highly resilient under pressure and prevent rebound because of the vacuum set up. All Canadian Pacific equipment being produced this year will have this new pad.

Turning Product Improvement Ideas into Action and Profit



This refrigerator freezing pan, a G. P. & F. production, is seamless drawn copper and weighs only 21 ounces.



G.P.&F. Has fifty years experience to guide you

New and improved products are appearing with great rapidity . . . imposing heavy sales penalties on those who are losing time in turning product improvement ideas into action. In countless instances the improvements have been achieved by replacing castings, forgings and wood parts with pressed metal parts.

The engineering staff of G. P. & F. has a background of fifty years experience to guide you in pressed metal design, saving you time and money and speeding your new or improved product to market.

The expert advice and suggestions of G. P. & F. engineers safeguard against costly mistakes. They assure you every advantage not only of a long and varied experience, but also of the full possibilities of pressed metal fabrication and economical production which the 19-acre G. P. & F. plant provides.

Turn your product improvement ideas into action and profit by consulting G. P. & F. engineers. There is no obligation.

GEUDER, PAESCHKE & FREY CO.

Sales Representatives in Principal Cities in All Parts of the Country

1389 St. Paul Avenue, Milwaukee, Wis.
364 W. Ohio Street, Chicago, Ill.

G.P.&F. STAMPINGS

GOLDEN ANNIVERSARY 1880-1930 GEUDER PAESCHKE & FREY CO. MILWAUKEE

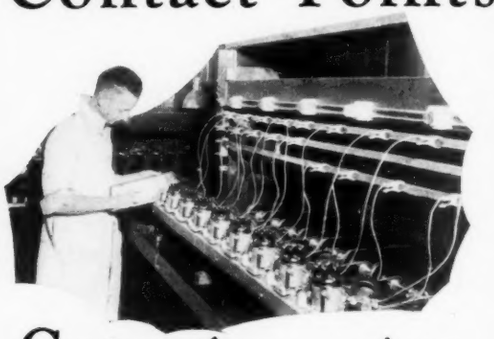
Send for this helpful Booklet . . .

"In Harmony With Modern Progress" was written to acquaint manufacturers with the complete story of what can be done with pressed metals. Send for your copy.

A-1115

RARE METALS AND ALLOYS

FANSTEEL
for
Contact Points



Cooperation . . given on development work

CERTAIN new types of Fansteel Tungsten or Molybdenum Contacts might improve performance materially, or might perhaps reduce costs without loss of efficiency.

Just ship a sample of your product, or a set of drawings to Fansteel's research laboratory. Trained metallurgists and engineers, unrelated to the sales department, will make careful tests and recommendations and submit them to you confidentially.

If necessary, special contact points will be designed for your product and samples made (for breakdown tests) to the specifications agreed upon by your engineers and ours. If standard contact points, kept in stock, will answer your requirements, yours will be the saving.

The Fansteel laboratory makes no charge for this valuable advisory and experimental service. You can't afford to pass up this offer?

Other Products

— TANTALUM —
. . a metal of remarkable properties

. . . an elementary metal . . . inert to corrosive chemicals . . . an electrolytic valve . . . becomes *harder* when heated . . . can be finished in iridescent colors . . . easily worked, machined and welded . . . full information on request.

TANTALUM · TUNGSTEN · MOLYBDENUM · CAESIUM · RUBIDIUM

FANSTEEL PRODUCTS COMPANY, Inc.
NORTH CHICAGO, ILLINOIS

Standards for Machine Pins Are Proposed

(*Concluded from Page* 35)

bility of cutting would be lessened. If the large ends were rounded the side bearing surface would not be deformed by the glanced battering of a hammer. The fifth objection dealing with lengths of reamers will be handled later as a distinct and independent project, but the problem can be simplified by defining clearly the longest pin of each nominal diameter. It is realized that a change-over to the new standard would involve some temporary inconvenience, but once established it would be simple to understand and apply. The taper of the proposed series is maintained the same, that is ¼-inch per foot, or a taper of 1 in 48. The small diameter of the pins is in the usual fractional dimensions, spaced by thirty-seconds from 1/16 to 3/16-inch diameter, by sixteenths to ⅜-inch diameter, by eighths to ¾-inch diameter and by quarters to 1-½ diameter. The number of diameters is reduced from 20 to 14 with a better arrangement of spacing. Fig. 1 gives the proportions and commercial lengths of the proposed series.

Cylindrical Pin Standards

Machine pins used as rod-end pins, pivots, dowels, idler pins, locating pins, etc., are not standardized to any extent in this country, and generally speaking, are not presented as a commercial article. Each designer is required to design his own pins, and each shop makes them according to these designs.

It now is being proposed to adopt a series of round cylindrical pins as an American standard. As shown in Fig. 2, these pins are quite similar to the taper pins proposed in Fig. 1. The radius on the ends is equal to ¼ diameter and offers the same advantages as given for taper pins. The suggested series of sizes numbers 94 which compares favorably with the variety adopted as standard on the European continent. The diameters and lengths of pins vary in much the same way as diameters and lengths of taper pins except that the maximum length is given as 8 diameters instead of 12 diameters. The use of well-defined proportions and commonly preferred sizes for diameters and lengths permits the expansion of the series for specific requirements and inclusion in the American standard at a later date.

In order to provide for various fit requirements three classes of tolerances are recommended. These tolerances are in the approximate ratio of 1:2:4 to provide for fine, medium and coarse fits, it being anticipated that pins within medium or grade B tolerances will become most common commercially.

FAST and SLOW MOTION

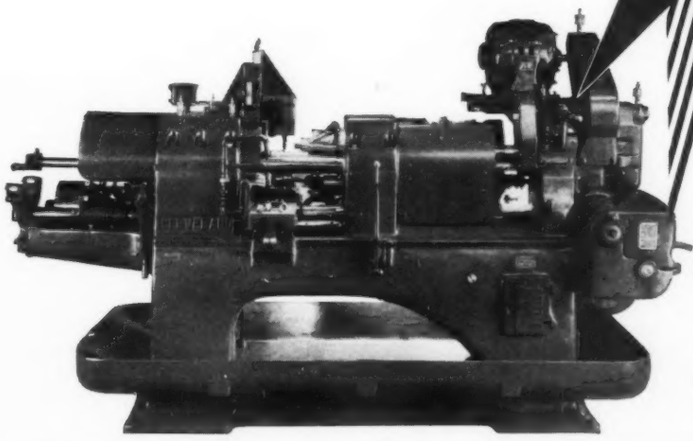
... AND FOR THE MAIN DRIVE, TOO ...

Single "Close Coupled" type Twin Disc Clutch, with compressed asbestos, gear tooth driving plates used when clutch runs dry.

The Cleveland Automatic Machine Co. manufactures automatic chucking, forming and screw machines. Control was not the least of the problems confronting their designers. But they found a more than satisfactory solution . . . Twin Disc Clutches.

In the model M 4 Cleveland spindle bar machine shown, a Twin Disc Clutch is used in the feed bracket to facilitate the machine's fast and slow motion. The fast motion is used in indexing the spindle turret, feeding the stock and advancing the tools to the work. When the tools reach the cutting position, the clutch is shifted to engage the slow motion on the working feed of the tools. And, in addition, the power clutch that drives the entire machine is a Twin Disc Cutch.

More than twelve years of specialization in the designing, building and engineering of clutches . . . wide and varied experience obtained from direct contact with the machine tool field . . . and from many standard and special models and sizes developed to meet its latest requirements . . . have fitted Twin Disc engineers to solve your control problems.



One or more of our stock models may be easily and economically adapted to your special need. Write our Engineering Research Department outlining your requirements. Engineering Data Book gladly mailed on request. ***Twin Disc Clutch Company, Racine, Wisconsin.***

TWIN DISC CLUTCHES

Order Now!

Penton's
Machine Shop Directory

ANYONE selling machinery, equipment or supplies to the leading manufacturers of the United States and Canada should use Penton's Machine Shop Directory. It is an invaluable ally to the advertising, sales and sales promotion departments as well as to the individual salesman. The directory will aid any company selling the machine shop field to amplify and correct its customer and prospect lists. Personalization of direct mail is made possible.

DATA is arranged alphabetically with a geographical cross index to facilitate use by sales territories, states or cities. The book contains names, addresses, principal products, personnel and other data on more than 5500 of the major companies operating manufacturing, contract or maintenance machine shops.

The price is $25.00, including postage, or less than one-half cent per company name.

Address your order to the

Book Department

Penton Publishing Co.

1213-35 West Third St.

Cleveland, Ohio

238-S.-M.D.

MEN OF MACHINES

(*Concluded from Page* 54)

gray iron castings, will answer technical questions received by the institute, and also will give technical advice to members on foundry operating problems.

* * *

E. S. Black recently was appointed research engineer for the Pettibone-Milliken Co., Chicago. He formerly was assistant to the president of the American Manganese Steel Co.

* * *

Charles H. Herty Jr., metallurgist, bureau of mines, Pittsburgh, has been appointed the 1931 Campbell Memorial lecturer. The American Society for Steel Treating in announcing this appointment again recognizes a man from the younger research workers' membership.

* * *

C. T. Crocker recently was appointed designing engineer of the aeronautic and marine department of General Electric Co., Schenectady, N. Y. In 1927 with the organization of the aeronautics and marine department he was made mechanical engineer, occupying that position until his recent appointment as designing engineer.

* * *

Rear Admiral David Watson Taylor, retired, has been presented the 1931 John Fritz gold medal, highest honor of the American engineering profession. The award was made unanimously by the board of award, comprising four representatives, one from each of four American societies of mechanical, electrical, civil and mining and metallurgy.

* * *

H. J. French, metallurgist, development and research department, International Nickel Co., Bayonne, N. J., was named recipient of the 1930 Henry Marion Howe gold medal. The award was made by the American Society for Steel Treating for the best technical paper published in *Transactions* during the past year. Announcement of the award and presentation of the medal were made at the recent meeting of the society at Chicago.

* * *

R. A. Schoenfeld has been made sales engineer at Chicago for Hevi Duty Electric Co., Milwaukee, manufacturer of electric heat treating furnaces. For seven years Mr. Schoenfeld has been sales manager for the Claud S. Gordon Co., Chicago, and prior to that was associated in engineering work with the Chicago Flexible Shaft Co., and the Barking Fuel Engineering Co. He is a graduate of Mayo college, now a part of Northwestern university, Chicago.

The flexible shaft *makes this machine possible . . . .*

THE illustration shows one of the many time and labor saving machines that owe their existence to the S. S. White flexible shaft.

It is used for smoothing the surface of concrete, stone and similar materials. The operator carries the motor at his back, suspended from the shoulder straps and manipulates the surfacing wheel by hand. Electrical connection to the motor is made by simply plugging in to the socket shown.

The advantage of this simple portable arrangement in cases where the work cannot be readily taken to the machine are obvious.

Without question there are many other operations, as for example grinding, buffing, paint scraping, drilling, polishing, etc., for which a similar arrangement would prove equally practical and advantageous.

The development of such machines is a comparatively simple problem since The S. S. White Co. offers a wide range of sizes and grades of shafts, with characteristics varied to meet any specific requirements.

These shafts represent the perfection of 86 years of pioneering and development. They are true-running, strong, durable and absolutely reliable,—shafts that insure trouble-free operation over long periods, even in the most severe service. And not least in importance is their *UNIFORMITY*. Every shaft is the exact duplicate of every other shaft of like specifications.

The Company has also aided many manufacturers in working out flexible shaft applications and is well qualified and always ready to co-operate in such development work.

Without obligation, full information, and quotations on specific requirements will be furnished on request. Address your inquiries to

Comprehensive handbook-FREE

To any engineer, designer or executive responsible for design, who makes the request on his business letterhead and states his position, a copy of this 120-page Flexible Shaft Handbook, containing engineering data, sizes, dimensions, etc., will be mailed without cost. Write for your copy today.

FLEXIBLE SHAFT HANDBOOK

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INDUSTRIAL DIVISION
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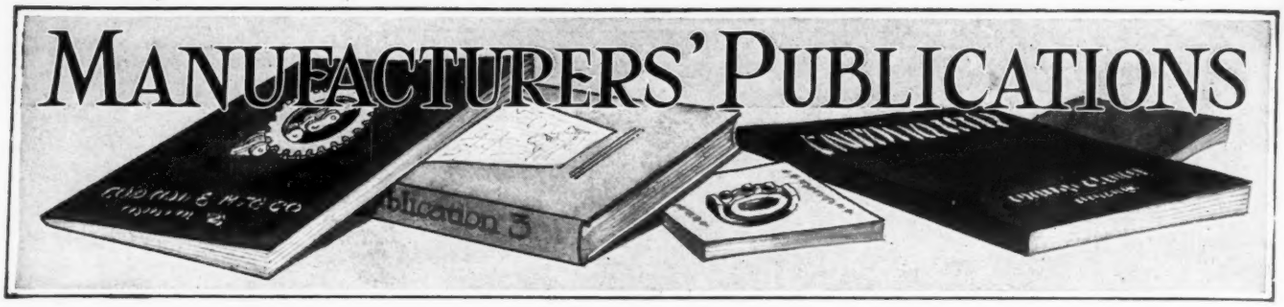
The S.S.WHITE Dental Mfg.Co.
INDUSTRIAL DIVISION
154 West 42nd Street, New York, N. Y.

MANUFACTURERS' PUBLICATIONS



Publications listed in this section may be obtained without charge from the manufacturers of the products or through MACHINE DESIGN

OIL SEALS—An interesting booklet recently was issued by Chicago Rawhide Mfg. Co., Chicago, describing its "Perfect" oil and grease retainers. A section of the contents is devoted to special information containing valuable data on the application of these oil and grease seals. In conclusion a table of standard sizes is given.

BALL BEARINGS—Strom Bearings Co., Chicago, has issued an illustrated catalog, No. 12, showing single row radial and double row radial bearings, 200 per cent and 300 per cent angular contact bearings and M.R.C. thrust bearings, with load rating dimensions and data for engineers and designers.

LUBRICATION—Lubrication Devices Inc., Battle Creek, Mich., has published a booklet describing its system of lubrication adapted to steel mill and other heavy duty equipment. It is illustrated, color being used effectively.

AUTOMATIC ARC WELDING—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has published a bulletin on automatic arc welding, containing welding data and describing welding applications. Comparison is given of automatic and hand welding and points out possible economies.

DIE CASTINGS—Aluminum Co. of America, Pittsburgh, discusses die castings in a new 24-page booklet and illustrates a wide variety of uses to which the castings are applicable. The text including charts, give a great deal of information covering the properties of Alco.

SHEET METAL PAINT—A bulletin by the American Chemical Paint Co., Ambler, Pa., covers preparation of sheet metal surfaces for painting. Photomicrographs show attacks of rust on metal surfaces cleaned by various means, including the company's cleaning preparation.

FORGINGS—A bulletin by the Camden Forge Co., Camden, N. J., gives pictorial and textual information on its hammered wrought iron forgings for railroad work, with microphotographic illustrations showing structure of the metal and tests showing its strength.

BELTING—Belting, hose, matting, packing and miscellaneous items for similar industrial use are covered in a bulletin by the Diamond Rubber Co., Akron, O. The cover of the bulletin was printed from rubber engravings, hand-cut from sheet rubber.

MOLYBDENUM—Climax Molybdenum Co., New York, meeting success with its publication on molybdenum in 1928 has issued a similar publication covering this metal and its development in 1929. It is compiled from data published in various media and is as free as possible from bias. It covers the use of this metal in nitriding, in acid-resisting alloys and steels, gray iron castings, alloy steel castings, aircraft, automobiles, and gives miscellaneous applications.

STEEL CASTINGS—Edgar Allen & Co. Ltd., Sheffield, Eng., has issued the third edition of its steel foundry book. It has been enlarged and redesigned, including data on the manufacture, heat treatment and properties of castings in seven kinds of steel. It gives a full description of conditions in steel foundry practice as an aid to buyers of castings.

CONTROL INSTRUMENTS—A folder showing its line of recording and control instruments is being circulated by the Brown Instrument Co., Philadelphia, in the hope it may suggest to users of industrial equipment means for obtaining savings in operation by their use. Each page is devoted to a suggestion for application of an instrument to an industrial unit.

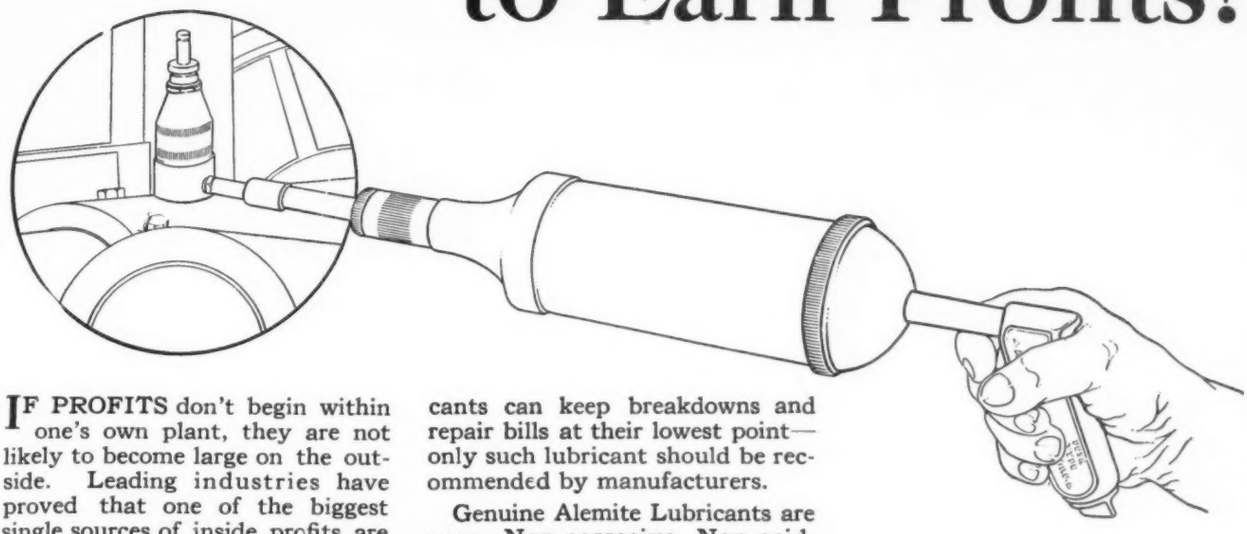
LIGHT AND PAINT—A booklet on the light reflection values of color in paint has been released by the New Jersey Zinc Co., New York. White generally is used in industrial establishments where the greatest amount of light is desired, but there are many instances where color is preferred. A chart illustrates the reflection values of various shades of colors.

WOUND ROTOR INDUCTION MOTORS—A 4-page leaflet describing the application and construction of type CW wound rotor induction motors has been published by the Westinghouse Electric & Mfg. Co. These motors have a wide field of usefulness for driving pumps and compressors and for other constant and varying speed, continuous duty services. The leaflet is identified as No. 20,490.

OXYACETYLENE PROCESS—Linde Air Products Co., unit of Union Carbide & Carbon Corp., New York, recently published the one hundredth issue of its monthly magazine, "Oxy-Acetylene Tips." Readers interested in the application of oxyacetylene parts and their design may have their names added to the mailing list to receive copies of the magazine regularly by sending their request to the company.

ELECTRICAL DEVICES—General Electric Co., Schenectady, N. Y., has published various bulletins recently on many of its products, including: Industrial heating devices; industrial haulage locomotives; hatchway limit

Where is the First Place to Earn Profits?



IF PROFITS don't begin within one's own plant, they are not likely to become large on the outside. Leading industries have proved that one of the biggest single sources of inside profits are to be found in the elimination of old-fashioned methods of lubrication and the substitution of efficient Alemite systems. Designers of machinery are, and of a right should be, the means of introducing these efficient systems to the manufacturer by incorporating them in the original production.

It is difficult to understand why designers will deliberately indicate old-fashioned grease cups and oil hole lubrication. If the cost of Alemite lubrication systems were prohibitive, it would perhaps be somewhat understandable. But their cost is very low and their savings so high as to be almost unbelievable until one has proved them in one's own plant.

Alemite Lubricants for industrial purposes are skilfully and specifically designed for every type of industrial operation. They do *not* "all come out of the same barrel" by a long shot. They are each individually designed for individual manufacturing conditions.

Only by using lubricants of such quality and efficiency can production costs be held to an irreducible minimum. Only such lubricants can keep breakdowns and repair bills at their lowest point—only such lubricant should be recommended by manufacturers.

Genuine Alemite Lubricants are pure. Non-corrosive. Non-acid. Never gummy. Always lubricate—at high temperatures or low.

The results obtained by foremost manufacturers of machinery by the use of Genuine Alemite Lubricants in Alemite High Pressure Lubrication Systems read like a page from the millenium. But they are true facts — facts which Alemite Corporation stands ready to prove to you *today!*

To merely make the statement that this combination will save its own cost and pay a 200% dividend thereon the first year is not nearly as convincing as to SEE it work out on machinery under typical manufacturing conditions. Only after you have proved it to your own satisfaction does Alemite Corporation *ask* you to believe.

Send for the Alemite plan of conducting a lubrication test under your own supervision. Everything is furnished you, including Cost Sheets. Really expert and helpful consultation is offered you entirely without obligation.

Alemite Corporation (Division of Stewart-Warner), 2644 N. Crawford Avenue, Chicago.

Industry's "Inside" Profit Maker—Alemite Systems and Alemite Lubricants

Here are the savings made possible by Alemite High Pressure Lubrication Systems when lubricated with Genuine Alemite Lubricants.

1. Saves 80% of Repair Bills and Breakdowns.
2. Saves 50% of Amount of Lubricant.
3. Saves 70% of Lubricating Time.
4. Saves 200% on Investment the First Year.
5. Saves in Belting and Other Materials.
6. Saves on Power by Reducing Friction to Minimum.
7. Saves on Cleaning Costs — No Leakage.

ALEMITE CORPORATION
(Division of Stewart-Warner)
2644 N. Crawford Ave., Chicago, Ill.

We want to conduct a lubrication test under actual operating conditions. Send us all information for conducting such a test.

Firm Name _____

Address _____

Your Name _____

City _____ *State* _____

285

ALEMITE PRODUCTS

switches; general purpose synchronous motors; drum controllers; synchronous motors for driving metal rolling mills; nonmetallic gears and blanks; industrial control.

IRON CASTINGS—A particularly difficult casting produced in its high-tensile cast iron is the subject of a leaflet by the Commercial Steel Casting Co., Marion, O.

SHEET STEEL GRADES — A booklet covering its grades of electrical sheet steel has been issued by the American Rolling Mill Co., Middletown, O. It is designed to aid buyers of these sheets to choose those best suited to their needs.

BILLET SHEARS—Shears for heavy duty cutting of billets and bars are described in a catalog by Henry Pels & Co. Inc., New York. Illustrations show the shears and details of construction. Tables of capacities and specifications are included.

ALLOY CASTINGS—Ohio Steel Foundry Co., Springfield, O., has issued a bulletin on its heat-resisting alloy for steel castings. The alloy is described and illustrations show a wide variety of uses to which it has been put in industrial work.

CANADIAN TRADE DIRECTORY—A directory of Canadian firms and Foreign firms represented in Canada in its twelfth annual edition has been issued by the Fraser Publishing Co., Montreal. It is devoted to the Canadian automotive, electrical, hardware, radio, machinery and allied industries.

ELECTRICAL HEATING—Industrial electric heating equipment forms the subject of a catalog of the Westinghouse Electric & Mfg. Co., industrial heating division, Mansfield, O. It contains a list of definitions, applications of furnaces, determination of sizes and descriptions of the various units of heating equipment.

AIR COMPRESSORS—Two bulletins on types of air compressors have been issued by the Pennsylvania Pump & Compressor Co., Easton, Pa. One covers a two-stage tandem-type compressor, power and steam-driven, the low pressure cylinder double acting and the high pressure cylinder single acting. The other describes a duplex, two-stage and duplex single stage compressor. Each bulletin is well illustrated.

AUTOMATIC CONTROL—Ryan, Scully & Co., 3711 Wissahickon avenue, Philadelphia, manufacturer of industrial furnaces, forges, conveyors and automatic control equipment, has published a catalog of its line of automatic control equipment for use with gas, air or liquids in connection with temperature and combustion control. It contains illustrations and diagrams showing operation, purposes and sizes.

NICKEL ALLOY STEEL FORGINGS—A technical bulletin has been issued by the International Nickel Co. Inc., New York, containing a reprint of a paper presented before the American Society for Steel Treating by Charles McKnight of its development and research department. It deals with the manufacture, uses, analyses, heat treatment and properties of nickel alloy steel forgings over four inches in diameter or the equivalent. Tables, charts and illustrations are included.

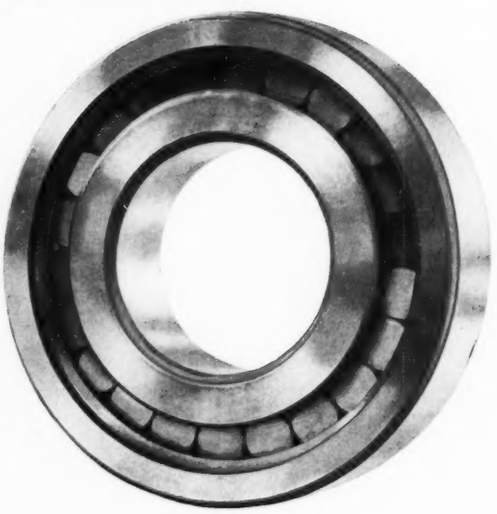
MOVEMENT

MOVEMENT is the method and Development of Life. From History and Nature we learn of Movement:

That movements sudden and spasmodic, wrenched into violent being out of inertia and unnatural repression, are dangerous and wasteful. Such are revolutions and volcanoes—and the starting movement of a plain bearing, wastrel of energy.

That movements developing smoothly, with an even acceleration, without obstruction to the applied forces, are harmonious with natural evolution and have maximum utility thru maximum efficiency; and such as these are the growth of an intelligently conducted business, evolution of a machine, the transition from a static to a dynamic state—movement on anti-friction bearings.

The former may often be necessary, but the latter are always preferable.



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COMPANY INCORPORATED
SYRACUSE NEW YORK
ROLLWAY CYLINDRICAL ROLLER BEARINGS

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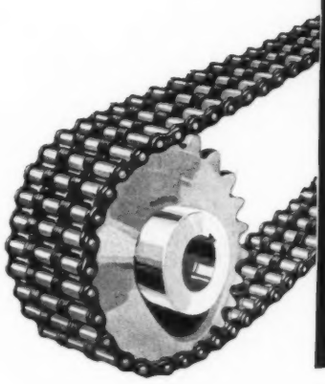

1/4 to 75
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1/1 to 8.4/1
RATIO

and up to 1800
R. P. M.

You can get a DIAMOND STOCK DRIVE to fit . . .

BESIDES the added convenience of immediate availability, Diamond Roller Chain Drives have very definite mechanical advantages. Rugged, efficient, quiet, rolling contacts which reduce friction, contact parts treated for wear resistance alone, simple in design and installation.

These features make Diamond Drives unsurpassed for durability, trouble-free service and low maintenance.

Drive Data Book No. 78 makes the selection of drives to meet your conditions as simple and efficient as the drives are mechanically. Send for this Book—it lists and describes the drives carried in stock by a distributor near you and at our plant.

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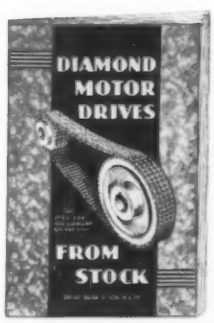

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ROLLING ~ AT POINTS OF CONTACT

Business Announcements and Sales Briefs

ENTIRE line of Gredag lubricants manufactured by the Acheson Graphite Corp., a unit of the Union Carbide & Carbon Corp., now is being distributed and sold by the carbon sales division of National Carbon Co. Inc., with headquarters at Cleveland. As in the case of its industrial carbon products, sales and technical service on all Gredag lubricants will be available at the branch offices and service plants of the carbon sales division.

* * *

Shawinigan Stainless Steel & Alloys Ltd., Montreal, Que., with foundry at Shawinigan Falls, Que., has begun the manufacture on a production basis of Nirosta metal castings which are heat and corrosion resistant. The company is licensee of the Krupp Nirosta Co. Inc.

* * *

Milwaukee Parts Corp., Milwaukee, has increased its capital from $53,000 to $150,000 to provide for expansion. The company has received government approval of a newly designed aircraft engine in development for more than five years.

* * *

Hill Clutch Machine & Foundry Co., Cleveland, recently announced the re-opening of its New York office at 30 Church street, under the management of Arthur L. Whiteside.

* * *

Worthington Pump & Machinery Corp., New York, has acquired the Gilman Mfg. Co., East Boston, Mass. The acquired company specializes in the manufacture of rock drilling machinery.

* * *

With the appointment of L. B. Mead, Indianapolis, to become assistant industrial manager of the northwest district of the Westinghouse Electric & Mfg. Co., William J. Morgan, Indianapolis, becomes Indianapolis manager for the firm.

* * *

Pratt & Whitney Co., Hartford, Conn., recently purchased the John-Sons Gauge Works, manufacturer of thread gaging and measuring tools, Hartford. Equipment and stock of the merged firm has been moved to the Pratt & Whitney Co. plant, Capitol avenue.

* * *

Brown Clutch Co., Sandusky, O., has increased its present force of workers as the result of the receipt of an order for cultivators for use in the sugar cane fields of South America.

* * *

Rawson Brake & Equipment Co., manufacturer of air brakes for automobiles and designer of automobile equipment, moved manufacturing activities from Detroit to Elizabeth, N. J., Oct. 1. The Rawson company has leased 10,000 square feet of space in the Durant plant at the latter location, which was recently taken over by Bayway Terminal Inc.

* * *

Armstrong Spring Co., Flint, Mich., has reduced its capitalization from $863,000 to $589,000.

* * *

Link-Belt Co., Chicago, has moved into its new plant and office at Paul avenue near Bayshore highway, San Francisco.

* * *

Lincoln Electric Co., Cleveland, recently announced the appointment of W. S. Stewart as assistant district manager in charge of the Cleveland territory with offices at the factory, Coit road and Kirby avenue. Mr. Stewart formerly was in charge of the Pacific coast offices of the company.

* * *

U. S. Tool & Mfg. Co., Detroit has awarded a contract to the Austin Co., engineers and builders, Cleveland, for the design and construction of a new plant on Kingsley street, Dearborn, Mich. The new plant will be a one and two-story steel frame structure 100 feet wide and 200 feet long, to be used for the manufacture of precision tools.

* * *

General Electric Co., Schenectady, N. Y., has plans made for an addition to its plant at Pittsfield, Mass., for the manufacturer of transformer tanks. It will be 150 x 550 feet and 70 feet high and will be all-welded. Steel and glass on a concrete foundation will exclude all brick and timber. An extension 27 x 350 feet will be used for offices.

* * *

Announcement has been made that Amplex Mfg. Co., newly formed subsidiary of Chrysler Corp., Detroit, will handle the sale of products other than finished cars and trucks manufactured by the latter company. Among the Amplex company's activities will be sales of Chrysler Oilrite bronze bearings, industrial motors and marine engines. Offices are located at 7900 Joseph Campau street, Detroit.

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The Philadelphia sales office of Cutler-Hammer Inc., Milwaukee, now is located on the tenth floor of the new Terminal Commerce building, 401 North Broad street, Philadelphia. These new quarters also include warehouse facilities where a stock of the C-H motor control, wiring device and safety switch items will be carried for immediate delivery. F. J. Burd is manager of the Philadelphia district.